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LECTURES ON MOTOR ANOMALIES OF THE EYES

I. PHYSIOLOGIC INTRODUCTION

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Ewald Hering, the master of the physiology of space sense and of the movements of the eyes, taught that the two eyes should be considered as the halves of a single organ (Hering's *Doppelauge*) as regards not only the visual but the motor apparatus. Unless the meaning of this doctrine is thoroughly understood it is impossible to avoid great mistakes in examining and analyzing the complicated anomalies to be considered in this study and to find the best, or only, method for their treatment.

The fundamental law of the visual apparatus concerns retinal correspondence: Each pair of corresponding retinal points has one direction in which the images situated on both points are localized. The principal visual direction, Hering's *Hauptsehrichtung,* belongs to both the foveae. Between this principal direction and the visual direction of any other pair of corresponding points is an angle determined by the arc between those points and the foveae. The center of the visual directions is situated either in the region of the imaginary "cyclopean" eye or, if one eye is dominant, in the nodal point of this. Equal stimulation of a corresponding pair of retinal areas mostly caused by one particular object outside produces a single sensation. But there are very few images which in near vision can be formed in corresponding parts of the retinas. The images of most objects are formed in noncorresponding (disparate) parts and therefore ought to be seen double. But actually, as a rule, they are not: If they are situated in the periphery of the visual field one pays no attention to them; if they are very near to the point of fixation, they are localized before or behind the plane in which appear the images formed on corresponding retinal points.

With the visual apparatus the motor apparatus is intimately connected. The primary function of the movements of the eyes is to bring the retinal images of objects which attract one's attention to lie in the areas of greatest visual acuity, the maculae. Although these movements are made almost automatically, they are not true reflexes. While true reflexes occur at their best in a state of inattention, ocular movements cease if the attention is diverted; that is, the visual stimuli are conveyed to the cortex, where they induce the ocular movements, while the path-

ways for true reflexes are subcortical. This statement holds good for every kind of ocular movement induced by sensorial, especially visual, sensations, be they in the same direction or in opposite directions (convergent, divergent, etc.).

E. Hering found and formulated the fundamental law of ocular movements: Every motor innervation arising from the cortical centers flows equally to both eyes, causing the associated muscles, called agonists and antagonists, to contract and relax, respectively. It is absolutely impossible to send a motor impulse to one eye only or a stronger innervation to one eye than to the other.

The validity of this assertion has been doubted by some writers, who refer to people who can move one eye alone, either in abduction or in adduction, or even up and down. But the fact that a single eye can be *moved* separately does not prove that the movement is produced by a *unilateral innervation.* I have seen and thoroughly investigated the cases of many such persons, and I have always succeeded in ascertaining that there was some kind of heterophoria, usually exophoria or hyperphoria. Such a person, if he possesses strong fusion power, can overcome the anomalous position of rest of his eyes and maintain binocular fixation for a long time. If he gets tired or his attention is diverted, although he continues to look in the same direction, one eye will move to its position of rest as a result of the weakening of the fusion tendency. But as soon as the attention is directed again to the point of fixation, the deviating eye will return to its former position and binocular fixation will be reestablished. During the unilateral movement, as has been proved, the other eye, in spite of keeping its position, is influenced by the same innervation impulses as the moving eye. To understand this fact, one must remember what happens if one puts a not too strong prism apex in before the left eye. After a moment of seeing double the point of fixation appears single again. And the same thing happens on removing the prism. Another person observing the subject's eyes closely during this experiment will notice a small movement of the left eye alone, at first inward and then back to the original position, whereas the right eye during the whole observation does not move at all.

After some training, most persons would be able, without a prism, to advert the right or the left eye alone and let it go back to its original position with the other eye looking straight forward. Figure 1 shows the experiment made with my own eyes. One looks at a distant point, a lamp or a white spot standing out on a dark background. Then one sends a gradually increasing convergence impulse to the eyes without giving up the fixation of the distant point, which appears double because of the convergence. If one succeeds in concentrating the attention on the left image only, while continually intensifying the con-

vergence impulse, there is an isolated movement of the right eye inward as long as the impulse increases, and a return to the original position as soon as the convergence impulse is withdrawn. The left eye remains unmoved during the whole experiment if the attention is carefully fixed on the image to the left. How does this agree with the assertion that both eyes are always equally influenced by the motor impulses? In the experiment just described there are two impulses, one for convergence and the other for turning the eyes to the left. Both impulses drive the right eye to the left, whereas the left eye is driven to the right by the convergence impulse and simultaneously to the left by the levoversion impulse. If both impulses have the same influence on the external and the internal rectus and these muscles are equally strong, the left eye must remain unmoved. The proof of the truth of this explanation has been given by E. Hering.[1]

Fig. 1.—One and the same distant point straight in front is fixed: in *A* with both (parallel) eyes, and in *B* and *C* with the left and the right eye, respectively, while the other eye is turned in because of a convergence impulse causing homonymous double images of the fixed point.

All of the illustrations in this paper (figs. 1 to 3) are from Bielschowsky, A.: Die Lähmungen der Augenmuskeln, in Graefe and Saemisch: Handbuch der gesamten Augenheilkunde, edition 2.

On examining the duction power by putting prisms of increasing strength, base down for instance, before the right eye, one will find that the patient cannot overcome a prism of about 7 degrees, whereas with a prism of 6 degrees he is able to see single. If the experiment is immediately repeated several times in succession and the prism strength is very slowly increased, the patient will bear stronger prisms in the later experiments without seeing double, till at last it will be found that a prism of 8 degrees is the limit beyond which he cannot go, however often the experiment may be repeated. The prism of 8 degrees is also the strongest which the patient can overcome if immediately afterward the prism is put in the reversed position, base up,

1. Hering, E.: Die Lehre vom binokularen Sehen, Leipzig, Wilhelm Engelmann, 1868.

before the other (left) eye. As long as he has such a prism before one eye, he is not able to overcome the weakest prism put in the reversed position before the other eye. This fact is to be explained only in one way: Although one eye alone is moving up or down behind the prism, both eyes are under the influence of an innervation to vertical divergence. An impulse for looking up or down is brought into play in order to keep the position of the fixing eye unaltered by compensating the effect of the vertical divergence innervation in this eye, while enlarging correspondingly the movement of the fellow eye.

The experiment just described as an evidence of the aforementioned law, that the innervation impulses always go equally to both eyes, is used besides for testing the duction power, or, to define it more exactly, the range of positive vertical divergence.[2] The fusion power varies not only between different persons but in the same person if the power is tested at different times: If he is tired or feeling sick he will display only a fraction or next to nothing of the amount of fusion range that will be obtained from him if he is fresh.

The limits of the different kinds of fusion movements are not at all rigid although, except for fusion convergence, they are independent of voluntary effort. I wish to emphasize this statement because it clashes with the usual opinion, which is wrong. This was discovered in 1900, when—at Hering's suggestion—I, in collaboration with my late friend, the excellent physiologist F. B. Hofmann, investigated in a long series of experiments with Hering's *Haploskop* the involuntary fusion movements.[3] They are produced, provided that one's attention is continuously concentrated on the images to be fused, without or even against one's will, and for this reason one speaks of *Fusionszwang,* or compulsion to fusion. If one of two identical objects which are placed in the *Haploskop* at a certain level and are fused is moved very slowly up or down, binocular single vision remains unaffected until a certain limit is reached, just as in the case of the prism test. After repeating the same experiment several times at intervals of not more than a few minutes, one will arrive at a limit for single vision far beyond that which was obtained in the first test: The degree of vertical divergence, increasing gradually from test to test, can at last amount to twice or even three times the degree arrived at in the first test. If now, without too long a pause, one tests in the same way the opposite kind of vertical divergence, one will get at best a small fraction, if any, of the amount

2. One speaks of positive vertical divergence (+ V.D.) if the right line of vision is directed upward or the left one downward; the reverse is called negative vertical divergence (— V.D.).

3. Hofmann, F. B., and Bielschowsky, A.: Ueber die der Willkür entzogenen Fusionsbewegungen der Augen, Arch. f. d. ges. Physiol. **80**:1, 1900.

that would have been obtained if this test had come first. But one will get about the same amount by repeating the latter test six times or more. This result is of practical value. As we were able to prove, the fusion innervation produced by the experiment described does not disappear immediately after the conclusion of the test; there remains a slowly diminishing latent residuum as a heterophoria, easily demonstrable by suspending binocular single vision. I shall come back to this point in discussing the difficulties in determining the position of rest. It is evident that one does not obtain the true range of any kind of fusion movement if one tests it only once and too immediately after having tested the contrary fusion movement. Either one must repeat the same test five or six times at short intervals until a constant amount of vertical divergence is obtained or one must wait at least fifteen minutes before testing the contrary kind of fusion movement.

As many oculists believe that the limits of fusion movements—except convergence—are rigid and that no amount of practice can enlarge them, I emphasize once more that this opinion is wrong, since it depends only on the *modus procedendi* of the experiment and on the time spent on it whether one finds, for instance, a superduction of 2 or of 5 degrees in a case of orthophoria. Therefore, it is not surprising to meet people who are able to overcome easily considerable amounts of vertical divergence—up to 20 degrees—caused by congenital paresis of the trochlear nerve or by concomitant hyperphoria. It is no wonder that in the case of people with orthophoria one cannot produce such an amount of vertical divergence, even if one makes them exercise for a long time. The ability of people who have been compelled from the earliest childhood to overcome congenital heterophoria is not to be compared with the result of experiments on adults who have never before had any opportunity for exercising the vertical divergence movement.

From what was said about vertical divergence one may conclude that for examining the vertical fusion range only two tests are needed, one for positive and another for negative vertical divergence, as exactly the same results are obtained whether one tests right superduction or left subduction. In both cases one is stimulating the positive vertical divergence innervation, just as one provokes the negative vertical divergence innervation by testing left superduction or right subduction.

What was said about vertical divergence holds good, mutatis mutandis, for another kind of fusion movements, namely, the rotations of the eyes round the visual axis (in opposite directions), by which the parallelism of the corresponding retinal meridians is lost. As these rotations are less important, in ophthalmologic work at any rate, one may omit consideration of them and turn to the third pair of fusion movements, those of divergence and convergence. They are important,

not only because they are so frequently needed for compensating esophoria and exophoria, but because there are paralyses of those movements which I must discuss later.

As to the lateral divergence innervation, what was said about vertical divergence holds good. One has to consider only the convergence movement. It has an exceptional position as the only one among the fusion movements which can be brought about not only by means of the compulsion to fusion, like the movements previously mentioned, but by free will. In the latter case convergence is always connected with accommodation and is produced by an impulse to look at a near point. If convergence is used as a real fusion movement, for instance by means of a prism base out, it occurs without accommodation. Voluntarily one can never converge the eyes without simultaneous accommodation. However, there is no doubt that the great range of tusion convergence in comparison with the very small range of other fusion movements depends on the frequent use of voluntary accommodation convergence.

The fusion movements, because of being independent of the will, have been wrongly taken for reflex movements, as I have explained. Up to the present time, only one kind of true reflex movements of the eyes is known, namely, those due to vestibular stimuli arising chiefly from varying postures of the head. The importance of such movements for the investigation of palsies will be discussed later on.

In considering the participation of individual muscles in the movements of the eyes one must keep in mind that by any and every motor impulse all the eye muscles are affected, even though the intended movement could be executed by one muscle alone. The practical value of this statement may be illustrated by one example. In ophthalmologic textbooks one reads that the superior oblique muscle turns the eye down and out, whereas the inferior rectus turns it down and in. Consequently the novice, not knowing that an innervation of one muscle alone does not occur, is inclined to assume that the inferior rectus is paralyzed if one eye looking down and in does not move as far as the other eye moves in the same direction (down and out). In fact, in such a case the superior oblique is paralyzed. For in looking down and in both the depressor muscles and the internal rectus cooperate. The more the eye is turned in, the less the inferior rectus is able to operate as a depressor because of the increasing angle between the visual line and the muscle plane of the inferior rectus, whereas the ability of the superior oblique to lower the eye increases as the line of vision approaches the muscle plane of the superior oblique.

I may refer here briefly to Sherrington's law of reciprocal innervation, one of the most important laws for ophthalmology, because of

its influence on operative procedures. The eye muscles act in two groups, one group as agonists, the other as antagonists, in various combinations, according to the intended movement. Sherrington demonstrated that the stimulation of the cortical center for a parallel lateral movement causes at the same time the contraction of the agonists, i. e., the muscles capable of turning the eyes to one side, and a relaxation of the antagonists, i. e., the muscles capable of turning the eyes to the opposite side.

ANOMALIES OF THE POSITION OF REST

One of the most important points to be considered in investigating the motor anomalies of the eyes is the position of rest. This depends on mechanical and nervous factors. To the former group belong the topographic conditions and the physical qualities of the tissues within the orbits, including those connected with the eyeballs, lids, conjunctiva, fat, fascial ligaments, etc., and also the size and form of the orbits and the bulbi. The nervous factors influencing the position of the eyes have been discussed before: the will, the sensory stimuli, the association of accommodation and convergence, the connection between the vestibular apparatus and oculomotor nerves and the reflex muscle tone.

Theoretically one must distinguish between the absolute, or anatomic, and the relative, or functional, position of rest. But one cannot ascertain the absolute position of rest because it is impossible to eliminate the totality of nervous influences. One can eliminate some of them, for instance the accommodation, by correcting any existing hypermetropia—further, the voluntary changes of position of the eyes by fixing them on a distant point; but one cannot exclude completely the effect of sensory stimuli on the motor nerves as long as the attention is attracted by visual impressions. It is totally impossible to exclude the reflex innervational factors, especially the variations in muscle tonus. Therefore, one has to be satisfied if one ascertains the relative position of rest, i. e., the position of one eye relative to the other. For this purpose it would be sufficient to eliminate only the innervations driving the eyes in opposite directions, that is, principally the fusion innervation and the innervation for near vision.

The innervation for near vision is easily eliminated by correcting any existing hypermetropia. It is much more difficult to eliminate the innervation arising from the fusion apparatus in cases of heterophoria. It is well known that the results obtained in testing for heterophoria are different at different times and under different conditions. Because of such experiences Marlow [4] recommended the prolonged occlusion test for making heterophoria manifest. But even that is not sufficient.

4. Marlow, F. W.: The Influence of Prolonged Monocular Occlusion in Revealing Errors of the Muscle Balance, Brit. J. Ophth. **4**:145 (April) 1920.

According to recent publications by Marlow and other writers, the results obtained from the occlusion test differ according to which eye is bandaged. The principal reason for this strange statement, as far as I can gather from the publications, seems to be either the rather frequently occurring complication of true heterophoria with so-called double or alternating hyperphoria, or a paresis not detected in the examination previous to the occlusion of the first eye. The latter possibility can easily be eliminated by a thorough examination following the rules still to be discussed.

ALTERNATING HYPERPHORIA

On the subject of double or alternating hyperphoria, I may be allowed to make some remarks because of the importance of this anomaly which is so frequently a complication of the typical concomitant as well as of the typical paretic motor anomalies of the eyes. Double hyperphoria is a peculiar anomaly the pure type of which is caused neither by mechanically acting factors representing the basis of the true heterophorias nor by a paresis. As far as I could find, the anomaly under discussion was first mentioned by Schweigger, Stevens and Duane about forty years ago. The interpretation given by these and other authors was wrong, as I have been able to prove by the thorough investigation of many hundreds of cases within the last thirty years. I cannot enter into particulars here as to the exceedingly varying symptoms of that anomaly, which I described in my exhaustive publication of three years ago.[5] Only one phenomenon, present in every case of alternating hyperphoria, need be mentioned as an indisputable proof of the incorrectness of the explanation just mentioned.

Each eye when covered moves upward. But if the eye behind the screen is observed while the other eye is fixed continually on a little lamp, one will see that the screened eye, instead of keeping to a certain degree of deviation, is moving slowly up and down at irregular intervals, not, as a rule, however, passing the horizontal plane in the downward direction. If one then puts in front of the fixing eye a darkening glass wedge (Zeiss), moving it in such a manner that the fixed lamp is gradually darkened, one will see that the covered eye will move downward below the horizontal plane in nearly exact proportion to the darkening of the fixing eye.

This phenomenon disproves the interpretation of double (alternating) hyperphoria given by the aforementioned authors, namely, that this anomaly is based on a muscular imbalance between the elevators and the depressors, the former being considered stronger. The spontaneous and isolated vertical movement of the screened eye, as well as its down-

5. Bielschowsky, A.: Die einseitigen und gegensinnigen („dissoziierten") Vertikalbewegungen der Augen, Arch. f. Ophth. **125**:493, 1931.

ward movement caused by the darkening wedge in front of the fixing eye, compels one to assume that there are intermittent nervous excitations of the vertical motors. These are probably based on a congenital disposition; they take place spontaneously, i. e., without any perceptible provocation as in the case illustrated by figure 2, but they are also produced in experiments in which the two retinas get considerably different stimulations, for instance, if one eye is covered or darkened. I cannot enter into the particulars which made me believe that the symptoms of double hyperphoria are due to alternating and intermittent excitations of both centers for vertical divergence, the one-sidedness of the vertical movements, as shown in the figures, being based on the coincidence of the voluntary fixation impulse with the involuntary action of one of the vertical divergence centers, so that the fixing eye keeps its position unaltered, as on this eye the innervations of the

Fig. 2.—Alternating (double) hyperphoria is shown. While the right eye *(A)* or the left eye *(B)* is in the primary position, the other eye is deviated upward.

elevators and depressors neutralize each other. From the proofs of the nervous origin of double hyperphoria one must conclude that it does not belong to the true heterophorias, and therefore one should not operate on a patient with pure double hyperphoria as if the condition were an anatomic position of rest. There is no need for any treatment in the case of patients endowed with good fusion power which masters the anomalous excitation of vertical divergence without any difficulty. Double hyperphoria is met with frequently combined with some kind of latent or manifest horizontal deviations. Figure 3 shows a patient with divergent strabismus. At times the squinting right eye is moving up (*B*) or down (*C*) while the fixing eye keeps its position unaltered. Notwithstanding this, one is entitled to assume that both eyes are influenced by the alternating and intermittent excitations of both the positive and the negative centers for vertical divergence but that the effect of these involuntary innervations on the fixing eye is

neutralized by a voluntary innervation of the elevators or of the depressors, respectively.

If one succeeds in correcting these horizontal deviations the double hyperphoria will disappear even without particular treatment. In my systematic and extensive investigations [6] concerning the position of rest in healthy people as well as in people suffering from eye strain or any kind of nervous trouble I found about the same incidence of heterophoria in both groups (more than 80 per cent), and in more than 41 per cent of the cases the heterophoria was combined with an apparently disassociated vertical deviation, which probably always is one of the various kinds of double hyperphoria. With regard to these experiences I never omit, in testing for muscular anomalies, to look for a possible complication with double hyperphoria or disassociated vertical deviation. One can verify it easily by putting a dark red glass in front of first the left eye and then the right eye. A patient with a typical alternating

Fig. 3.—Dissociated vertical divergence is shown. The left eye is directed at a distant point, the right eye alternately being deviated outward *(A)*, out and up *(B)* or out and down *(C)*.

hyperphoria will always see the red light below the yellow light, whether the right or the left eye is behind the red glass; whereas a patient with concomitant or paretic vertical divergence will locate the red light now below, now above, the yellow light according to whether the red glass is in front of the right or the left eye. Of course one has to exclude the possibility that these different results are due to paresis, of which the difference between the primary and the secondary deviation is a characteristic. The differential diagnosis is easily made if one tests the vertical distance of the two images not only in the primary position of the eyes but in all the cardinal secondary positions by getting the patient to look right, left, up, down, etc. In a case of paresis, the amount of vertical deviation differs considerably in accordance with

6. Bielschowsky, A.: Ueber die relative Ruhelage der Augen, Ber. ü. d. Versamml. d. ophth. Gesellsch., Heidelberg **12**:67, 1913.

the change of visual direction, whereas a disassociated vertical divergence is hardly or not at all influenced by the change of visual direction.

I shall not enter into particulars concerning heterophoria more than is necessary to distinguish between the real motor anomalies and the anomalies of position, in view of their frequent coincidence. Therefore, I shall not speak either about the troubles which patients with heterophoria complain of or about their treatment. I should like, however, to make a few general remarks about heterophoria, which may be divided into exophoria, esophoria, hyperphoria and cyclophoria. Concerning exophoria, I do not think it useful to differentiate between that for distance and that for near vision. In regard to the therapeutic problems, real heterophorias, which are anomalies of the anatomic position of rest, must not be confounded with anomalies of nervous origin. From this point of view, I do not recognize insufficiency of convergence as exophoria if there is perfect muscular balance for distance. Of course, exophoria is often combined with insufficiency of convergence, but the former anomaly may in proper cases be corrected by operation, whereas, because of its nervous origin, it would be a great mistake to operate for mere insufficiency of convergence. For, although the operation would, by transforming orthophoria into esophoria, improve the position of the eyes for near work, it would cause trouble in distant vision. It may be suggested that Landolt has reported perfect results obtained by advancement of the internal rectus muscles in cases of pure insufficiency of convergence. But I have no doubt that the patients had undisclosed exophoria besides insufficiency of convergence and that the improvement obtained by operation is to be attributed to the removal of exophoria.

The same considerations apply to esophoria. Since Donders discovered the connection between convergence and accommodation, one has not thought of operating for esophoria without a very careful examination of the refraction and an exact correction of any hypermetropia present. The disappearance of esophoria in consequence of wearing convex glasses proves the absence of true esophoria, i. e., of an anomalous position of rest. The relation between accommodation and convergence is the most frequent but not the only cause of the tendency to abnormal convergence. There are rare cases without any hypermetropic refraction showing a temporary convergence, mostly latent but at times manifest, of an inconstant amount. In such cases one has to deal with spasms of the convergence apparatus, the cause of which it is often impossible to discover, except that the great majority of the patients present symptoms of a neuropathic constitution. I shall return to these spasms when I discuss the divergence palsies.

Concerning hyperphoria, I have discussed before how to distinguish between a double or disassociated hyperphoria as an anomaly of nervous

origin and hyperphoria, both concomitant and paretic, as an anomaly of the position of rest. Instead of using many terms, such as hyperphoria, hypophoria or cataphoria, anaphoria and so on, in the cases under discussion, I suggest that one speak of positive or negative vertical divergence, according as the right visual axis tends to turn upward or downward relative to the left one. If, however, the anomaly is caused by paresis of a single elevator or depressor muscle or of a group of them, one should not speak of hyperphoria or vertical divergence but should denominate the particular paresis precisely.

Cyclophoria is the name for a tendency to abnormal rotation of the eyes round the sagittal axis so that the corresponding retinal meridians are not parallel any more. This anomaly, which always follows paresis of one of the vertical motors is seldom met with as a heterophoria of nonparetic origin. I think it wrong to lay great stress on this anomaly as a cause of many complaints, for several reasons. First, I cannot remember a case in which I was able to connect the complaints of the patient with nonparetic cyclophoria. Second, it is well known to physiologists that the corresponding retinal meridians, as a rule, are not parallel but deviate 2 degrees or more from parallelism. Finally, I know, from the investigations mentioned before on involuntary fusion movements, that under the influence of the fusion tendency meridian (rotating) deviations of 10 degrees and more can be brought about easily, the vertical meridians thus diverging or converging above. In ocular palsies the meridian deviation can be a very annoying symptom, which I shall discuss later.

The methods of investigation employed in heterophoria I shall not enumerate in detail. A person who is thoroughly familiar with the physiology of the visual and motor apparatus of the eyes needs no more than a few simple instruments in daily practice. And the oculist who does not possess this physiologic knowledge, even if complicated and expensive instruments are used, will not be prevented from making bad mistakes.

The chief object of the tests for heterophoria is to eliminate the fusion tendency as much as possible, so that a latent anomalous position of rest will become changed into a manifest deviation. I advise my pupils always to begin the investigation with an objective test. While the patient's eyes are directed straight forward at a distant light, one covers each eye alternately, observing, after the screen has been taken away, whether the eye moves, and if so in which direction, in order to achieve fixation. From this the kind and the amount of such movement can be estimated and it can be learned, besides, whether in the following subjective tests for measuring the deviation the answers of the patient are reliable. For inhibiting the fusion tendency a dark red glass held before one eye will be sufficient in most cases. It must be dark enough

to eliminate all retinal images except the image of the little electric lamp in the middle of the Maddox tangent scale. If the patient is asked where he sees the red lamp, he will fix the lamp with the eye behind the red glass so that the red image lies in the fovea. In a case of exophoria or esophoria the red image is seen covering the number to which the visual line of the second eye is directed; in one of hyperphoria, it is seen above or below that number. It should be particularly noted that in measuring a paretic deviation the eye behind the red glass is the fixing eye, so that the primary deviation is determined if the red glass is held before the normal eye, and the secondary deviation, if the red glass is before the paretic eye. My own practice is in the beginning of the investigation to combine the red glass with a prism of about 10 degrees, because the red glass alone sometimes fails to produce diplopia. The displacing effect of the prism held alternately, base in or base down, first before one eye and afterward before the other eye, must of course be taken into consideration in the measurement of the deviation. For instance, if there is no vertical diplopia in spite of the placing of a prism of 10 degrees base down before the right eye, one must infer a right hyperphoria of 5 (arc) degrees, which is verified if the same prism base up before the right eye or base down before the left eye produces a vertical diplopia of 10 (arc) degrees.

After having measured the primary and secondary deviations in the primary position of the head and of the eyes one must ascertain whether there is a change of the deviation to be recorded in looking to the right or to the left, or up or down. Instead of moving the lamp fixed by the patient one turns his head so that he has to move the eyes in the opposite direction in order to keep the fixation unaltered. Then the diplopia is tested while the head of the patient is tilted to the right and to the left side around the sagittal axis, the eyes being directed straight forward. The purpose of this test will be explained in connection with the discussion of palsies of the vertical motors.

Frequently the complaints of patients do not correspond with the smallness of the amount of heterophoria found in the tests described. If, in spite of correcting any existing error of refraction, these tests do not elicit commensurate diplopia, one must surmise that they are inadequate to bring about complete relaxation of the fusion innervation. This supposition is confirmed if in repeated tests the amount and the kind of deviation differ considerably. It is impossible, as I have emphasized, to eliminate from the oculomotor apparatus all the various nervous influences, so that only the absolute or anatomic position of the eyes remains. Because of the ever present and ineliminable activity of the fusion innervation one cannot determine even the functional or relative position of rest, even if by means of the devices mentioned the stimuli to fusion are removed. The results obtained by the prolonged occlusion

test are, as mentioned before, indeed valuable but applicable only to a relatively small percentage of patients. However, one can arrive at an approximately reliable measure of the latent deviation by one or two examinations by using the prism duction test. In any case of heterophoria the patient is able to overcome by abduction or superduction, etc., a strong prism, much stronger than that which people with orthophoria can bear without seeing double. On the other hand, the contrary prism duction is in the case of the same patient much smaller than in orthophoria, even if the second test is repeated several times. For instance, the patient will overcome easily a prism of 10 degrees base down placed before the right eye, and only a prism of 1 degree base down or not even that before the left eye. From this one can infer a positive vertical divergence (right hyperphoria) which under normal conditions of seeing is kept latent by the negative vertical divergence innervation. This compensating innervation is made to relax gradually by putting prisms of increasing strength base down before the right eye or base up before the left eye. The strongest prism which the patient can bear without seeing double is a little greater than the amount of the right hyperphoria because, after having relaxed the negative vertical divergence innervation, the patient begins to use his positive vertical divergence innervation in order to overcome the increasing prism strength. If at the very moment of the appearance of diplopia the prism held before one eye is replaced by a dark red glass, the distance between the two images indicates the kind and approximate amount of the heterophoria.

RÔLE OF THE GONOCOCCUS IN PURULENT OPHTHALMIA IN WARM CLIMATES

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There are a few landmarks of clinical observation to be mentioned in considering the part played by the gonococcus in hot climates where trachoma is common or perhaps universal. The first was the recognition by Muller, in 1898, that the infiltration of the superficial layers of the cornea by trachomatous granulation tissue, or pannus, is a means of defense against damage of the cornea by ulceration caused by gonococcic conjunctivitis.

The second was the observation made by Morax, in 1901, that there is no such condition as acute trachoma, and that acute signs occurring in a trachomatous subject are the result of a superimposed infection with gonococci or other known bacteria.

It is probable, moreover, that the presence of trachomatous conjunctivitis predisposes the membrane to infection by gonococci, or, in other words, that the trachomatous conjunctiva provides an excellent culture medium for these organisms.

It is to be noted that in Palestine and Egypt the gonococcus has not a venereal origin but is transferred from eye to eye mainly by means of fingers, garments and towels. The part played by flies in the transmission of bacterial infections of the eye is not known with certainty but is believed to be small. Ophthalmia neonatorum is extremely rare both in Palestine and in Egypt, while in London 259 patients were treated in 1932 at the special hospital for patients with this disease.

Gonococcic conjunctivitis is characterized by the frequency of subacute and chronic forms and is much less fulminating even in its acute forms than the cases I used to see in London thirty years ago. I have not seen a case of gonococcic conjunctivitis in an adult during the last ten years in London. It therefore occurred to me that the organism met with in Egypt in gonococcic conjunctivitis was not the same as the organism causative of gonococcic urethritis or as that which causes gonococcic conjunctivitis in Europe. I obtained the cooperation of the late Dr. Beaton, bacteriologist to the Egyptian government, for the purpose of determining this point.

The patients examined were children with purulent conjunctivitis, and the investigation was confined to a consideration of the nature of the gram-negative diplococci occurring in the discharge. Twelve patients

were examined, and in each case films were prepared for microscopic examination and material was placed on suitable mediums for cultivation.

The films all showed gram-negative diplococci contained in leukocytes of the discharge, the appearance of which differed in no way from the characteristic aspect of typical gonococci in gonorrheal pus.

The gram-negative diplococci were obtained in culture from four patients, the tubes inoculated with material from the others having remained sterile or having yielded a growth of other micro-organisms only.

The possibilities to be considered were that the cocci might be gonococci, meningococci or members of the two groups of gram-negative cocci of limited pathogenicity found frequently in the normal throat and designated as Micrococcus catarrhalis and Micrococcus pharyngis-siccus, or that they might be a specific and hitherto unrecognized type of coccus.

The characters of the colonies and the conditions by which their growth was limited may be regarded as excluding M. pharyngis-siccus. The morphologic characters of the four strains of cocci and the appearance of their colonies on serum agar differed in no way from those of two strains of gonococci obtained from patients with urethritis. In all six strains the same limitation of growth on mediums containing serum, the same short viability of the cultures and the same uncertainty in the development of the subcultures were observed.

Gonococci and meningococci differ in their action on the two carbohydrates dextrose and maltose when growing on solid mediums containing them. Gonococci are able to form acid from dextrose only, while meningococci do so from both dextrose and maltose. The four strains were cultivated on mediums containing these sugars and were found, as do gonococci, to produce acid only from dextrose.

It would have been interesting to determine to what extent the various strains were related to one another and to strains of genital gonococci, and Dr. Beaton had commenced the preparation of immune serums with this object in view when, to my great regret, he died suddenly.

The conclusion to be drawn from the investigations described is that there is no reason to suppose that there is any difference between the gonococci found in cases of gonococcic conjunctivitis and those present in gonococcic urethritis.

An account of this research was published in the Seventh Annual Report of the Ophthalmic Section of the Department of Public Health of Egypt for 1919.

In 1929, without making any reference to our previous work, Haig repeated the details of Beaton's research and experimented with immune serums. His conclusions did not differ from those of Beaton published in the *Bulletin of the Ophthalmological Society of Egypt* in 1929.

RÔLE OF THE GONOCOCCUS IN CAUSING CORNEAL ULCERATION

In 1919 my assistants in Egypt and I examined films from 3,504 patients with conjunctivitis. We found that ulceration of the cornea occurred in 920 patients, though in only 12 did the ulceration occur after the patient had come under treatment. This study was repeated in 1921, when smears from 14,540 patients with conjunctivitis were examined; 3,718 of these patients suffered from corneal ulceration, and only 25 were under treatment at the time the ulceration began. It may be noted that the number of patients examined was four times greater in 1921 than in 1919.

The results show that in Egypt the pneumococcus is considerably more dangerous to the cornea than is the gonococcus; the incidence of the various organisms (percentages of the cases of ulceration in which they were isolated) was as follows:

Organism	Incidence, Per Cent 1919	1921
Pneumococcus	36.27	51.24
Diplobacillus	35.92	24.24
Gonococcus	30.23	27.39
Mixed infection	26.90	30.90

While, as has been said, it is believed that pannus has some protective effect on the cornea, if trichiasis entropion is present the cornea is rapidly destroyed in gonococcic and other varieties of acute conjunctivitis, whether or not treatment is undertaken.

Dr. Sobhy Bey, while bacteriologist at the Egyptian Ophthalmic Laboratory, carried out in 1919 a research to determine the nature of the normal conjunctival flora in Egypt, with special reference to the possible presence of gonococci, in 100 pupils of a neighboring school, all of whom were trachomatous but none of whom had acute conjunctivitis. The research was carried out in November and described in my 1919 report.

The result was as follows:

Organism	Incidence, Per Cent
Diplobacillus of Morax	38
Koch-Weeks bacillus	2
Pneumococcus	8
Influenza bacillus	2
Uncertain	2
Gonococcus with other organisms	1
No organism found	47

A similar examination of the conjunctival flora was carried out in the same month and in the same district near Cairo on 120 patients all

of whom were trachomatous but none of whom had acute conjunctivitis, with the following result:

Organism	Incidence, Per Cent
Diplobacillus of Morax	34.1
Koch-Weeks bacillus	16.6
Pneumococcus	5.8
Other organisms	0.8
Gonococcus	6.6
Mixed infection	3.3
No organism found	32.5

As a further control, the staff of 24 employees of an ophthalmic hospital in the same place were examined in the same month. As far as I remember, they were all trachomatous, though one or two of the doctors may have been free. In 22 cases the smears were negative; in 1 case the diplobacillus was present with other organisms, and in 1 case a gram-negative coccus was found. The result surprised me. I should have thought that being constantly in the company of patients with heavily infected conjunctivae they would have yielded more organisms.

It is to be noted that this research was carried out in the cool month of November. The results would, I suppose, have been very different if the month had been July.

RELATION OF GONOCOCCIC CONJUNCTIVITIS TO ATMOSPHERIC TEMPERATURE

The annual rise of temperature after the winter in Egypt begins during March and continues until June. At the government ophthalmic hospitals in 1931 the number of new patients rose to 40,000 in March from 18,000 during February. By June the number of new patients seen and treated had gone up to 78,000; this was the peak attendance per month. Afterward there was a decline in the number of those seeking treatment mainly for trachoma with a superimposed acute or subacute conjunctivitis. However, judging by film bacterial preparations examined under the oil immersion lens of the microscope, the acme of gonococcic infection is not reached until September, for in that month gonococci were found in 69 per cent of all of the cases in which the conjunctival flora was investigated. There is little doubt that numerous persons maintain a chronic gonococcic conjunctivitis throughout the winter and provide foci for the spread of the condition when the atmospheric temperature rises in the spring.

It is interesting that at Assuan when the temperature rises to 40 C. and remains at about this point the gonococcus ceases to flourish and cases of acute gonococcic conjunctivitis are less prevalent.

AGE AT WHICH BLINDNESS FROM ACUTE CONJUNCTIVITIS OCCURS

According to Strathearn [1] there is a close association between age and the incidence of blindness in Palestine. This is marked up to the age of from 10 to 15 years both in boys and in girls. Thereafter the incidence falls abruptly in boys; but in girls at this, the marriageable, age, it remains high until the age of about 30.

In Egypt it did not occur to me to separate the sexes in the preparation of statistics for the year 1921. Taken together, 113,201 new patients came to the various hospitals for treatment. Of those who were under 1 year of age, 4.68 per cent were already blind in one or both eyes. Of those between 1 and 5 years, 6.73 per cent were blind in one or both eyes. The percentages worked out similarly for the various five year periods showed figures increasing from about 6 per cent in the age group from 1 to 5 years to about 40 per cent in the group over 70 years.

This may mean that the risk of supervention of blindness increases throughout life or that as age increases there is an increasing unwillingness to seek treatment at ophthalmic hospitals unless blindness has occurred; cataract and glaucoma (glaucoma is twice as common in Egypt as in Europe) may account for the greater incidence of blindness in persons of 30 years and over, or the constantly recurring attacks of conjunctivitis with corneal ulceration may lead to destruction of the visual acuity. The definition of blindness which has been adopted is inability to count fingers at a distance of 1 meter.

SUMMARY

While trachoma during the hot weather predisposes to infection with gonococcic conjunctivitis, the presence of pannus affords some degree of protection to the cornea against ulceration.

The organisms which cause gonococcic conjunctivitis are identical with those which cause gonococcic urethritis.

The rôle of the gonococcus in the development of corneal ulceration is discussed.

The influence of atmospheric temperature on gonococcic conjunctivitis is considered.

The age at which blindness from acute conjunctivitis supervenes is statistically noted.

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SURFACE ANESTHESIA IN OPHTHALMOLOGY

COMPARISON OF SOME DRUGS USED

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Up to the present time no work has been published on the determination of the relative value of the newer surface anesthetics used by the ophthalmologists in this country. Marx,[1] Hoffmann[2] and Schornstein[3] have compared the drugs commonly used on the continent. Clinical reports on the individual preparations have recently been made as follows: on butyn, by the Committee on Local Anesthetics, of the Section on Ophthalmology of the American Medical Association,[4] on *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride by Wilmer and Paton[5] and Rauh[6] and on nupercaine, by Dillon and Greer[7] and Bochner.[8] This work was undertaken to compare the effect of 2 per cent cocaine, 2 per cent metycaine, 1 per cent butyn, 1 per cent phenacaine, 0.5 per cent *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride and 1 : 500 nupercaine.

Cocaine, the oldest and the best known of these drugs, has several objectionable features, i. e., its effect on the corneal epithelium, pupil and intra-ocular tension, and its habit-forming properties. On the other hand, it is the only local anesthetic that produces vasoconstriction. In addition to overcoming the undesirable effects of cocaine, an ideal anesthetic should be of low cost and toxicity, boilable without loss of effectiveness and compatible with epinephrine.

From the Department of Ophthalmology, Northwestern University Medical School.

This investigation is one of a series to be undertaken for the Committee on Standards of Ophthalmic Instruments and Drugs, Section on Ophthalmology, American Medical Association.

1. Marx, E.; Mendes da Costa-Vet, E.; Naar, C., and Wolff, L. K.: Klin. Monatsbl. f. Augenh. **81**:433, 1928.

2. Hoffmann: Ztschr. f. Augenh. **78**:20, 1932.

3. Schornstein, T.: Ztschr. f. Augenh. **80**:234, 1933.

4. Bulson, A. E.: Butyn, a New Synthetic Local Anesthetic: Report Concerning Clinical Use, J. A. M. A. **78**:343 (Feb. 4) 1922.

5. Wilmer, W. H., and Paton, R. T.: Am. J. Ophth. **16**:106, 1933.

6. Rauh: Ztschr. f. Augenh. **82**:135, 1933.

7. Dillon, E. E., and Greer, C.: Use of Nupercaine in Ophthalmology, Arch. Ophth. **10**:674 (Nov.) 1933.

8. Bochner, M. K.: Use of Nupercaine in Ophthalmology, Arch. Ophth. **10**: 763 (Dec.) 1933.

METHOD OF INVESTIGATION

The normal human cornea was tested for the effectiveness of the surface anesthetics. Because one knows the force used, a von Frey's hair makes a suitable means of applying the stimulus. This consists of a handle made of wood to which a hair is attached at an angle of 110 degrees. The amount of pressure exerted by this can be accurately determined by means of a chemical balance. If one applies the hair perpendicular to one pan until the bending point, the force can be obtained from the weight, which balances it, on the opposite pan. By varying, the length of the hair and its diameter, one obtains a graduated series. Von Frey termed the force gmm,^{2} because the total effect depends not only on the weight applied but also on the surface area covered, i. e., on the number of corneal nerve endings that are stimulated. In this work the 2 gmm^2, 5 gmm^2, 10 gmm^2 and 20 gmm^2 hairs were used. Since the application of a 2 gmm^2 hair to any part of the normal cornea causes pain, this was chosen as the minimal stimulus.

PROCEDURE

After the size of the pupil and the accommodation were determined, the subject was placed in a reclining posture. The cornea was touched with a 2 gmm^2 hair at five places, i. e., the center of the cornea, superiorly, inferiorly and laterally near 3 and 9 o'clock. The reason for this is given later. Then the eye was directed to a horizontal position, and 1 drop of the solution to be tested was placed on the center of the cornea. Only 1 drop was used because with the more powerful anesthetics 2 or more drops would cause loss of sensitivity too marked to be measurable by this method. Furthermore, the prolonged duration of the anesthesia would be unpractical. The time was kept by means of a stop-watch. To avoid error due to variations in the size of the drop, the same dropper was used in all the cases. The lids were held open for several moments to prevent forcible closure and loss of solution.

At the end of thirty and sixty seconds and at one minute intervals after that, the depth of anesthesia was tested with the various hairs. As the anesthesia increased or decreased so did the amount of stimulus required to produce pain. A Schiötz tonometer is tolerated without pain when the cornea is insensitive to a 20 gmm^2 hair. In all cases in which the cornea was sufficiently insensitive the tension was taken. The pain and congestion produced by the solution and any change in the size of the pupil, palpebral fissure or accommodation were recorded. After the test the corneal epithelium showed fine defects perceptible only with the slit-lamp where the stimuli had been applied.

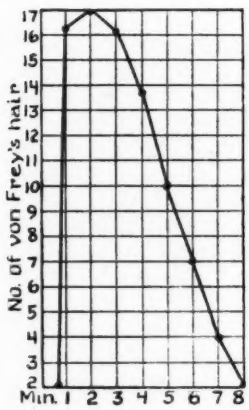

Fig. 1.—Average results obtained with cocaine.

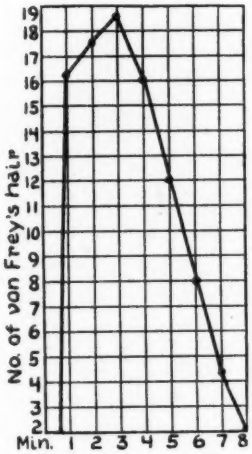

Fig. 2.—Average results obtained with butyn.

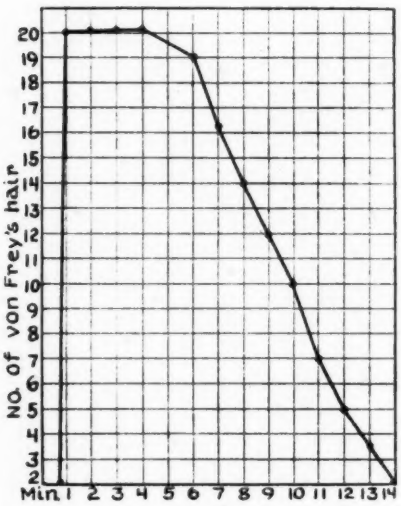

Fig. 3.—Average results obtained with *p-n* butylaminobenzoyl-dimethyl-amino-ethanol hydrochloride.

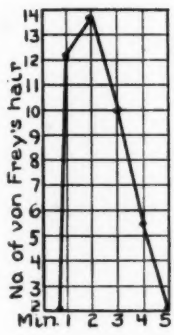

Fig. 4.—Average results obtained with metycaine.

Errors can be avoided by observing several precautions. The hair is applied perpendicularly to the surface, so as not to scratch the corneal surface; scratching causes a sensation of pain sooner than if the stimulus is correctly applied. Furthermore, because the sensitivity of the cornea varies in its several parts, one area of the cornea often recovers from the anesthetic influence more rapidly than another. For this reason, at the beginning of the examination, one determines whether the 2 gmm² hair produces pain equally in the five sections mentioned. The return of sensitivity in any of these areas is recorded as the end-point for that stimulus. Another cause of confusion is the smarting and burning produced by the anesthetic, or the visual sensation caused by the pressure of the stimulus on the cornea. The application of the 2 gmm² stimulus to the other eye offers the subject a means of comparing

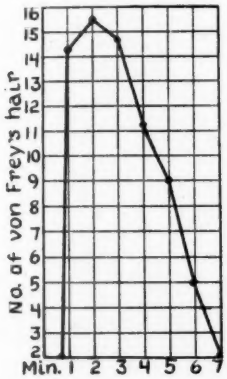

Fig. 5.—Average results obtained with phenacaine.

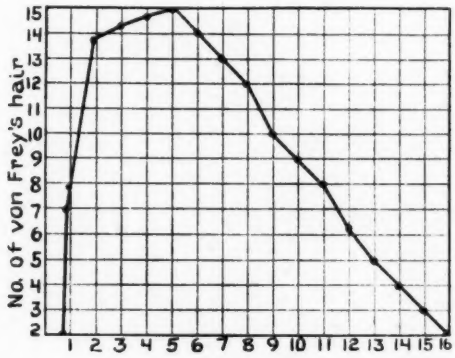

Fig. 6.—Average results obtained with nupercaine.

these sensations with that of pain. Since the summation of rapid successive stimulation causes a painful sensation, the stimuli should be applied only once to each area and at one minute intervals.

Twenty normal eyes were tested with each of the anesthetics named. Table 1 shows the results obtained with 1 per cent butyn. Similar tables were made for the other drugs, but are omitted to conserve space.

A study of these reveals that the effectiveness of an anesthetic depends on the degree of insensitivity produced and on its duration. These two factors are independent. This is shown by nupercaine which produces anesthesia of longest duration and by *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride which causes the greatest loss of sensitivity, i. e., anesthesia to stronger stimuli. In general, however, a drug that causes a great depth of anesthesia causes anesthesia of long duration, and vice versa. Furthermore, subjects vary in their susceptibility to the influence of an anesthetic. The individual differences are slight with the more effective drugs.

TABLE 1.—*Results Obtained with 1 Per Cent Butyn*

Patient	Size of Pupil, Mm.	Initial Stimulus	Minutes ½	1	2	3	4	5	6	7	8	9	10	11	12	Tension	Congestion	Initial Pain	Size of Pupil,* Mm.	Corneal Epithelium	Accommodation
1.....	3½	2	2	10	10	10	5	5	2	2	2+	..	..	..	..	15.0	+	+	3½	—	—
2.....	3	2	2	15	15	20	20	15	15	10	10	5	5	2	2+	18.5	+	+	3	—	—
3.....	3	2	2	20	20	20	20	10	10	5	5	2	2	2+	..	17.0	++	++	3	—	—
4.....	3½	2	2	15	15	20	20	15	10	5	5	2	2+	..	..	16.0	+	+	3½	—	—
5.....	2	2	2	20	20	20	20	15	10	5	2	2+	..	..	..	20.0	+	+	2	—	—
6.....	4	2	2	20	20	20	15	15	10	5	2	2+	..	..	..	20.0	+	+	4	—	—
7.....	3½	2	2	20	20	20	15	10	5	2	2+	2+	..	..	..	18.0	+	+	3½	—	—
8.....	3¾	2	2	15	20	20	20	15	10	5	2	2	2	2+	..	15.0	+	+	3¾	—	—
9.....	3½	2	2	15	15	15	15	10	5	2	2+	2+	..	..	..	19.5	+	+	3½	—	—
10.....	3½	2	2	20	20	20	20	20	20	15	15	10	5	2	2+	18.0	+	+	3½	—	—
11.....	3	2	2	10	15	15	10	5	2	2+	2+	2+	..	..	..	25.0	++	++	3	—	—
12.....	3	2	2	10	10	20	15	15	10	5	2	2+	..	..	..	19.5	+	+	3	—	—
13.....	3¾	2	2	10	15	20	15	5	2	2+	2+	2+	..	..	..	18.0	+	+	3¾	—	—
14.....	3	2	2	20	20	20	15	10	5	2	2+	2+	..	..	..	18.0	++	+	3	—	—
15.....	4	2	2	20	20	20	15	10	5	2	2+	2+	..	..	..	17.0	+	+	4	—	—
16.....	3½	2	2	20	20	20	20	15	10	5	2	2+	..	..	..	18.0	+	+	3½	—	—
17.....	3¾	2	2	20	20	20	20	20	15	5	2	2+	..	..	..	15.5	+	+	3¾	—	—
18.....	3	2	2	20	20	20	20	10	5	2	2	2+	..	..	..	21.5	+	+	3	—	—
19.....	3½	2	2	20	15	15	15	10	5	2	2+	2+	..	..	..	18.0	+	+	3½	—	—
20.....	3	2	2	20	20	20	20	10	5	2	2	2+	..	..	..	19.5	+	+	3	—	—

Strength of von Frey's Hairs

* This denotes the size of the pupil after the test.

Table 2 shows the average results with each drug. The numbers represent the von Frey's hairs to which the cornea is insensitive at the various time intervals.

The influence of an anesthetic may be plotted graphically (fig. 7). If the degree of insensitivity is represented along the ordinate by the line *AB* and if the time is represented along the abscissa by the line *AC*, the line drawn from *B* to *C* represents the return of sensitivity.

TABLE 2.—*Average Results for Each Drug*

Drug	Minutes															
	½	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cocaine	2	16.2	17.1	16.3	13.6	9.9	6.9	4.4	2.7	....	...	...	...	...	...	...
Metycaine	2	12.1	13.6	9.8	5.5	2.2	....	....	....	....	...	...	...	...	...	...
P-n butylaminobenzoyl-dimethyl-amino-ethanol hydrochloride	2	20.0	20.0	20.0	20.0	19.7	18.1	16.4	13.9	12.0	9.8	6.4	5.1	4.1	...	...
Butyn	2	16.0	17.5	17.2	16.5	11.0	7.0	3.1	....	....	...	...	...	...	...	...
Phenacaine	2	14.2	15.3	14.9	11.3	9.0	4.7	....	....	....	...	...	...	...	...	...
Nupercaine	..	6.7	13.7	14.2	14.4	14.9	14.1	13.1	11.9	10.2	8.8	7.6	6.4	5.1	3.8	2.9

TABLE 3.—*Surface Value and Anesthetic Index for Each Drug*

Drug	Percentage of Base	Surface Area	Anesthetic Index
Cocaine	89	1,658	1.00
Metycaine	88	750	0.45
Butyn	86	1,850	1.10
Phenacaine	85	1,340	0.81
Nupercaine	90	2,880	1.74
P-n butylaminobenzoyl-dimethylamino-ethanol hydrochloride	88	3,862	2.33

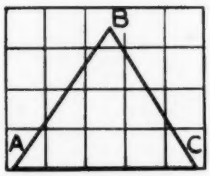

Fig. 7.—Graphic representation of the influence of an anesthetic.

The figure thus produced is called by Marx (fig. 7) the "triangle of insensitivity". Such a figure is obtained with the weak anesthetics. With the more powerful anesthetics the decline of insensitivity does not follow immediately after reaching the peak but runs almost horizontally for one or more minutes before dropping. This produces a rectangular figure. By computing the surface area enclosed by these lines, i. e., the height of anesthesia and its duration, a mathematical means of comparing the effectiveness of the anesthetics is afforded. The number of squares enclosed by the graphic figure represents numerically the total effect of the anesthesia.

Graphs plotted from the average results given in table 2 are shown in figures 1 to 6. The numerical value of the surface area enclosed by the figures produced with each anesthetic was determined. If the surface value of 2 per cent cocaine is considered as unity, the anesthetic index of each drug is found. Table 3 shows the numerical value of the surface of the graphs and the anesthetic index of the drugs. The percentage of base in the salt is shown, proving that the differences in effectiveness are not dependent on the varying ratio of the amount of base to that of the salt.

PAIN, CONGESTION, COST

The solution of cocaine causes a mild initial burning or smarting. At the end of the examination the conjunctival vessels are usually constricted. It is the only drug in this series that produced drying of the corneal epithelium and enlargement of the pupil and palpebral fissure. Of all the substitutes for cocaine tested, butyn in a 1 per cent solution caused the slightest, while phenacaine caused the most, pain and congestion. These effects of metycaine, nupercaine and *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride were moderate.

There is a notable difference in the cost of these drugs. Nupercaine in 1 : 500 solution is by far the least expensive; in this dilution the cost is from one-fifteenth to one-twentieth that of *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride, which is the most expensive of this group. Two per cent metycaine and 1 per cent butyn, which are approximately the same in cost, are purchasable at less than one-half the price of *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride, but are about twice as expensive as 1 per cent phenacaine and 2 per cent cocaine. Therefore arranged in order of cost, beginning with the cheapest, they are: 1 : 500 solution of nupercaine, 1 per cent phenacaine, 2 per cent cocaine, 1 per cent butyn, 2 per cent metycaine and 0.5 per cent *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride.

SUMMARY

Two per cent cocaine and metycaine, 0.5 per cent *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride, 1 per cent butyn and phenacaine and nupercaine 1 : 500 were compared as surface anesthetics. Except with nupercaine, the initial stimulus, i. e., a 2 gmm² hair, is not perceived within thirty seconds; the greatest depth of anesthesia is reached at the end of two minutes. From this a practical point suggests itself, namely, that the tension can be taken satisfactorily at the end of two minutes, and that the usual manner of giving drops several times at two minute intervals is unnecessarily long.

With cocaine a marked loss in sensitivity occurs in thirty seconds; however, the greatest insensitiveness is not reached until the end of two minutes. A slight loss in anesthesia occurs at the end of three minutes,

and then the decline is more rapid. The normal stage, when a 2 gmm² hair produces pain, is reached at the end of eight minutes. Cocaine, therefore, produces a marked anesthesia of moderately long duration.

Butyn was used in the 1 per cent instead of the usual 2 per cent solution, because this has been found sufficiently satisfactory for clinical purposes such as tonometry and removal of foreign bodies. Furthermore the cost is halved, and in this dilution butyn does not cause the marked sensations of burning complained of by most patients on using the 2 per cent solution. The action of 1 per cent butyn is like that of 2 per cent cocaine, except that the height of the anesthesia is greater and the peak maintained longer. Needless to say, a 2 per cent solution of butyn would show an anesthetic index still greater than that of cocaine.

TABLE 4.—*Properties of the Anesthetics Studied*

Order of Effectiveness	Strength of Solution	p_H	Percentage of Base in the Salt	Comparative Cost	Time of Maximum Action, Minutes	Duration in Minutes
1. P-n butylaminobenzoyl-dimethylamino-ethanol-hydrochloride....	0.5%	6.7	88	20×	1	13-14
2. Nupercaine.....	1:500	5.6	90	1×	5	16
3. Butyn.....	1%	6.0	86	10×	2	8
4. Cocaine.....	2%	4.6	89	5×	2	8
5. Phenacaine.....	1%	5.2	85	5×	2	7
6. Metycaine.....	2%	5.6	88	10×	2	5

One per cent phenacaine and 2 per cent metycaine are less effective in the order named than the two preceding drugs. With these products the height of the anesthesia and its duration are distinctly less than with butyn or cocaine.

The greatest loss of corneal sensitivity in this series was produced by *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride. Because the maximum stimulus used was the 20 gmm² hair, one does not know from this test how much more stimulation the cornea could have borne without feeling pain. The peak of anesthesia is maintained until the end of six minutes, when a rapid decline to the normal sensitivity occurs (fig. 3).

Nupercaine is a somewhat slower acting anesthetic than the others. Forty-five seconds are required before the original stimulus becomes unperceivable, and five minutes are needed before the greatest insensitiveness is attained. After this point is reached, a gradual decline occurs, and the normal condition returns at the end of sixteen minutes. Therefore, nupercaine is a slow acting anesthetic of a moderate depth and a very long duration. A comparison of the properties of the various anesthetics is shown in table 4.

CONCLUSIONS

A word of caution is necessary. According to Marx [9] the corneal sensory perceptions are limited to pain only. Therefore, the results obtained from the corneal test should not be applied to the conjunctiva or other mucous membranes and to infiltration anesthesia. The greatest depth of anesthesia is produced by *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride, and the longest duration, by nupercaine. The degree of insensitiveness and its duration are quite marked with butyn and cocaine, moderate with phenacaine and slight with metycaine. The anesthetics in their order of effectiveness are 0.5 per cent *p-n* butylaminobenzoyl-dimethylamino-ethanol hydrochloride, 1 : 500 solution of nupercaine, 1 per cent butyn, 2 per cent cocaine, 1 per cent phenacaine and 2 per cent metycaine.

9. Marx, E.: Die Empfindlichkeit der menschlichen Hornhaut, Leipzig, S. Hirzel, 1925.

ACTION OF EPINEPHRINE ON THE NORMAL HUMAN EYE

USE OF THE STRONGER SOLUTIONS FOR INSTILLATION

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Within the past fifteen years there have appeared numerous papers, especially in foreign journals, dealing with the treatment of certain types of glaucoma with preparations of the suprarenal gland. It was early recognized that the procedure is not unattended by dangerous complications. Although more clinical investigation will be necessary to evaluate and standardize the method, it appears to be the consensus, at least of American ophthalmologists,[1] that epinephrine should be used only in certain cases as a temporary measure until operation can be safely undertaken and in cases in which operative intervention is contraindicated. Rarely may glaucoma be controlled indefinitely by epinephrine alone.

Aside from the therapeutic uses of the preparations of the suprarenal gland, a further value lies in the happy combination of mydriasis with reduction in the intra-ocular tension which is produced by the stronger (2 per cent) solutions on their local instillation into the conjunctival sac. As a diagnostic measure for study of the media and fundus in glaucomatous eyes, or those suspected of being glaucomatous, in which the use of atropine derivatives or similar substances is contraindicated or dangerous, the value of the instillation of epinephrine is readily realized.

As the American articles heretofore published deal solely with the effect of epinephrine on the intra-ocular pressure in cases of glaucoma and contain little or no reference to the changes in pressure following its application to normal human eyes, I determined to study the action of the drug on a series of one hundred normal patients selected at random from the ophthalmic outpatient clinic at Grady Hospital. The present paper, therefore, deals with a purely pharmacologic investigation.

As is well known, epinephrine stimulates the adenoneural and myoneural junctions of the sympathetic nervous system. In consequence, the effect exerted on any particular organ or tissue depends on the

1. Gradle, H. S.: Illinois M. J. **53**:126 (Feb.) 1928. Post, L. T.: Laevo-Glaukosan and Epinephrine Bitartrate in Treatment of Glaucoma, Arch. Ophth. **11**:187 (Jan.) 1934. Daily, R. K., and Daily, L.: Texas State J. Med. **25**:292 (Aug.) 1929.

nature of its sympathetic innervation, which may either inhibit or stimulate. The relaxation of the bronchi in asthmatic persons following an injection of epinephrine furnishes an excellent example of sympathetic inhibitory action, whereas the generalized vasoconstriction and subsequent elevation of blood pressure afford an equally good illustration of a stimulant effect.

The eye receives two sets of sympathetic fibers, one conveying impulses to the blood vessels, particularly those of the vascular tunic and iris, and the other innervating the dilator muscle of the iris. The fibers are believed to arise in the midbrain, whence they proceed to a synapse with neurons in the lower cervical and the upper thoracic level of the spinal cord. Axons originating from the latter neurons make their exit from the cord in the anterior rami of the first and second thoracic nerves and ascending in the cervical sympathetic chain terminate about neurons in the superior cervical ganglion. From the superior cervical ganglion certain fibers conveying vasoconstrictor impulses, after coursing in the sheath of the internal carotid artery, pass through the ciliary ganglion and enter the eyeball in the short ciliary nerves.

The fibers to the dilator muscle of the iris take a somewhat different path after leaving the superior cervical ganglion. They pass through the gasserian ganglion and after traveling for a short distance in the nasal branch of the ophthalmic division of the trigeminal nerve leave it to form the long ciliary nerves which enter the eyeball anterior to the short ciliary nerves.

In laboratory animals, stimulation of a sympathetic nerve in the neck causes marked mydriasis and vasoconstriction of the eye on the same side, but after extirpation of the superior cervical ganglion such effects are not obtainable. In a curarized rabbit, faradic stimulation of a cervical sympathetic nerve induces a 40 per cent drop in the intra-ocular tension within the first few seconds of stimulation.[2]

The instillation of epinephrine into the eye of the rabbit is followed by dilatation of the pupil, blanching and shrinking of the conjunctiva and constriction of the retinal arteries. After degeneration of the terminal sympathetic nerve endings following removal of the superior cervical ganglion, a similar though greater response is observed,[3] indicating that the site of action of the drug is the so-called sympathetic receptive substance at the junction of the nerve endings and the muscle cells. A drop in the intra-ocular tension usually occurs.

In the cat and the dog and in man a 1 : 1,000 solution of epinephrine usually is insufficiently concentrated to evoke mydriasis unless injected

2. Romer: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. **46**:57, 1927. Romer and Krebs: Ztschr. f. Augenh. **53**:13, 1924.

3. Meltzer and Auer: Proc. Soc. Exper. Biol. & Med. **1**:47, 1904. Lewandowsky, M.: Arch. f. d. ges. Physiol. **73**:288, 1888.

subconjunctivally. In man, in certain diseases accompanied by a heightened irritability of the sympathetic nervous system, notably hyperthyroidism,[4] mydriasis may be produced by the topical application of a 1 : 1,000 solution. Dilatation of the pupil may result from this concentration of epinephrine in cases of diabetes mellitus. This reaction at one time was considered a test of pancreatic insufficiency but later was proved to be due to hyperglycemia and easily prevented by lowering the blood sugar.[5]

In man, changes in the intra-ocular pressure were early noted by many observers[6] following the instillation or injection of concentrated solutions of epinephrine into the eye, and these observations eventually led to the adoption of the drug in the therapy of glaucoma. In the steadily accumulating reports on the subject, while the effectiveness of epinephrine in reducing the intra-ocular tension is consistently granted, there is no little disagreement as to the precise mechanism involved.

It is generally accepted that the aqueous arises from the blood plasma and lymph in the uvea and ciliary body. Although evidence has been produced to show that it is a secretion rather than a dialysate, it is not yet definitely known whether the fluid is formed by a process of filtration or represents a true secretion of the ciliary epithelium.[7] Whichever is the origin, the fluid is continuously formed and after passing around the free margin of the iris into the anterior chamber proceeds against resistance through the ligamentum pectinatum iridis and thence escapes into the venous circulation by way of the canal of Schlemm. The final intra-ocular tension is dependent on a delicate adjustment between the formation and the escape of the fluid. Whenever the blood pressure in the uvea is increased, a correspondingly greater quantity of intra-ocular fluid is produced and the tension rises. This has been verified experimentally in the dog by showing that the tension varies directly within rather wide limits with the blood pressure in the carotid artery.[8] Unquestionably, the intra-ocular tension is to a large extent determined by numerous other factors of which ophthalmologists are

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4. Loewi, O.: Wien. klin. Wchnschr. **20**:1, 1907; Arch. Exper. Path. & Pharmacol. **59**:83, 1908.

5. Loewy and Rosenberg: Biochem. Ztschr. **61**:189, 1914.

6. (*a*) Wessely: Ber. u. a. Versamml. ophth. Gesellsch. **28**:69, 1900; Jahresk. f. ärztl. Fortbild. **20**:1 (Nov.) 1929. (*b*) Rupert: Biochem. Centralbl. **8**:898, 1909. (*c*) Hamburger: Med. Klin. **19**:1224, 1923; **20**:274, 1924; Klin. Monatsbl. f. Augenh. **72**:47, 1924; Ztschr. f. Augenh. **60**:109, 1926. (*d*) Romer and Krebs.[2] (*e*) Ungerer: Bull. Soc. d'opht. de Paris **40**:348, 1928. (*f*) Schmidt: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. **46**:50, 1927.

7. Adler, F. H.: Is Aqueous Humor a Dialysate? Arch. Ophth. **10**:11 (July) 1933.

8. Starling, E. H.: Principles of Human Physiology, Philadelphia, Lea & Febiger, 1912.

ignorant, at present, such as venous pressure, capillary circulation and alterations in the osmotic tension of the blood, lymph, etc.

Epinephrine, by virtue of its powerful vasoconstrictor influence, first produces ischemia of the uvea, accompanied usually by a reduction in the intra-ocular pressure,[5a, c] although occasionally an initial temporary rise in pressure is observed. During this primary stage of vasoconstriction, the enucleated eyeball is lighter and of diminished volume.[5b] The drop in tension is explained by one school on the basis of depletion of the blood within the eyeball. The vasoconstriction induced by epinephrine is replaced in about forty-five minutes by a pronounced vasodilatation, during which the enucleated eye has been shown to be heavier and of greater volume, although a lowered intra-ocular pressure persists. The ingenious explanation offered to account for this drop in pressure is that although the diminished tonus of the blood vessels permits their passive dilatation with resultant ocular engorgement, it also checks the compressing effect of the vascular tunic on the intra-ocular contents. In addition, drainage of the uvea is improved and venous stasis is replaced by arterial hyperemia and improved tissue nutrition. Those who accept this theory believe that the initial rise in pressure sometimes noted after instillation of epinephrine is due to compression of the intra-ocular contents by the hypertonic blood vessels immediately following the instillation. A similar theory of vascular hypotonus is offered to account for the softening of the eyeball during certain inflammatory diseases of the eye in which the vasoparesis may be due to products formed as a result of the disturbed metabolism.[2] Histamine produces such a vasoparesis. One worker asserted that the drop in pressure results from mydriasis, which allows freer drainage of the intra-ocular fluid from the posterior chamber around the margin of the iris to the anterior chamber.[9] The knowledge that the pressure is just as markedly reduced if miotics are used in conjunction with the epinephrine renders this theory untenable.

According to some authors, epinephrine exerts a direct action on the ciliary epithelium besides its vasoconstrictor effect. It has likewise been contended [10] that as a result of the ischemia of the uveal tract produced by the epinephrine there is induced an anoxemia of the ciliary epithelium which by inhibiting its secretory activity lowers the intra-ocular pressure. Supporting this theory is the observation that the appearance of fluoresceine in the anterior chamber following intraperitoneal injection is delayed in an eye treated with epinephrine.

Following its local absorption from one eye, epinephrine may be transported to the opposite organ and there produce similar changes of

9. Knapp, A.: Tr. Am. Ophth. Soc. **19**:69, 1921; Arch. Ophth. **50**:556, 1921.

10. Seidel: Ber. u. d. Versamml. ophth. Gesellsch. **45**:14, 1925. Serr: Ber. u. d. Versamml. ophth. Gesellsch. **45**:255, 1925.

a lesser degree. This was commented on several years ago.[11] However, in most instances the mydriasis and the drop in pressure are negligible or very slight.

Epinephrine is rapidly absorbed from the conjunctival sac and in susceptible persons may give rise to alarming symptoms. These are usually observed in patients suffering from thyrotoxicosis and in those with a hyperirritable sympathetic nervous system unassociated with organic disease. The symptoms are similar to those following overdosages of the drug and consist of palpitation, tachycardia, precordial distress, tremor, nausea and vomiting. Collapse may occur, but, as far as I am aware, no death has been reported in the literature from the use of epinephrine in the eye.

EXPERIMENTAL STUDY

In the present study observations were made on fifty men and fifty women in whom there was no demonstrable evidence of ocular disease. Tension was measured with a Schiötz tonometer, and no patient showing a tension below 15 mm. or above 25 mm. was included in this group.

A 2 per cent solution of a synthetic epinephrine preparation was employed. The drug is supplied in ampules containing 0.091 Gm. of the powder and representing 0.05 Gm. of active epinephrine substance. To secure a 2 per cent solution, the contents of one ampule were dissolved in 2.5 cc. of sterile distilled water. Because of the instability of aqueous solutions of epinephrine, no solution was used after it had stood for over twenty-four hours.

The procedure adopted in each case was as follows: After a careful preliminary ophthalmologic examination the tension in each eye and the diameter of the right pupil in millimeters were recorded. Then four instillations of 1 drop each of the 2 per cent epinephrine solution were made into the conjunctival fold of the right eye only, at ten minute intervals. One hour following the last instillation, the size of the right pupil and the tension in each eye were again recorded. The patient was instructed to return in approximately twenty-four hours, at which time a final determination of the tension and pupillary diameter was made. The various recordings for each patient in the entire series are shown in the accompanying table.

Analysis of the results obtained in the right eye (into which the epinephrine had been instilled) shows that in 58 per cent of the cases there was no change in tension after one hour but a distinct drop at the end of twenty-four hours. The reduction varied from 1 to 11 mm., with an average of 6.2 mm. A lowering of the pressure was observed

11. Rentz: Klin. Monatsbl. f. Augenh. **73**:356, 1924. Hamburger,[6c] Romer and Krebs.[2]

Data for One Hundred Patients

Case No.	Sex	Age	Tension Before Instillation		Tension After 1 Hour		Tension After 24 Hours		Diameter of Pupil Before Instillation, Mm.	Diameter of Pupil After 1 Hour, Mm.	Diameter of Pupil After 24 Hours, Mm.
			Right	Left	Right	Left	Right	Left			
1	M	52	18	22	18	22	15	22	3	10	3
2	M	43	18	20	16	20	12	20	3	7	3
3	M	47	18	18	15	18	13	18	4	7	6
4	F	52	15	15	15	15	13	15	3	7	4
5	F	53	18	18	18	18	13	18	4	8	3
6	F	17	18	18	15	18	15	18	7	7	5
7	M	72	15	18	18	18	15	18	2	4	1½
8	M	31	15	15	15	15	13	15	5	7	5
9	F	18	15	18	15	18	7	15	6	7	7
10	F	44	18	18	18	18	18	18	4	7	3
11	M	75	15	15	13	15	8	15	5	7	R. 4 L. 5
12	F	49	15	15	18	15	13	15	4	7	3
13	F	39	25	23	22	23	15	22	3	9	3
14	M	70	18	18	15	18	15	18	3	9	3
15	F	13	22	22	15	22	9	22	3	9	3
16	F	32	18	18	18	18	13	18	2	8	2
17	F	38	15	15	13	15	11	18	3	9	3
18	M	25	18	15	15	15	9	13	2	6	2
19	M	52	15	18	15	18	8	18	5	8	3
20	F	49	13	13	11	13	8	13	4	8	4
21	M	40	15	15	15	15	15	15	3	8	3
22	M	17	15	15	15	15	8	15	3	9	3
23	F	56	18	18	15	18	11	15	4	8	4
24	F	39	18	18	18	18	8	15	4	8	4
25	F	39	15	15	15	15	12	15	3	9	4
26	F	61	22	22	22	22	15	20	4	7	4
27	F	35	18	18	18	18	13	18	3	6	3
28	M	36	18	18	18	18	18	18	4	9	3
29	M	61	15	15	15	15	12	12	4	5	3
30	F	39	22	22	18	22	13	22	3	9	3
31	F	48	18	18	18	20	18	18	3	8	4
32	F	37	25	22	27	22	13	20	5	8	4
33	M	15	22	25	22	25	15	25	7	9	7
34	M	35	18	20	15	20	12	22	3	10	3
35	F	24	25	22	20	22	18	22	4	9	6
36	F	52	18	18	18	18	15	18	3	9	3
37	F	41	18	18	15	15	8	15	3	10	3
38	F	49	18	18	15	18	8	15	4	10	4
39	M	56	15	15	15	15	11	13	3	9	3
40	M	55	18	18	18	18	9	20	3	6	3
41	F	38	20	20	20	20	15	20	4	9	3
42	M	22	22	22	20	22	18	22	3	8	3
43	M	34	23	25	23	25	12	25	3	9	3
44	F	16	18	18	18	18	12	18	6	10	6
45	F	19	20	20	16	20	13	20	4	9	4
46	M	34	18	18	18	18	9	15	3	9	3
47	F	36	15	12	15	12	12	12	3	7	3
48	M	33	25	25	25	25	18	25	4	9	3
49	F	15	18	18	15	15	13	18	4	5	4
50	F	48	25	25	25	25	15	25	4	10	3
51	M	42	20	20.	20	20	11	20	3	7	4
52	M	34	18	20	18	20	13	20	3	6	3
53	M	18	18	18	18	20	13	20	2	9	3
54	M	19	22	22	22	22	15	20	2	8	2
55	M	28	25	18	22	18	18	18	3	9	3
56	M	64	25	25	22	25	11	25	3	9	3
57	M	58	15	18	15	18	9	18	4	9	4
58	F	62	23	23	23	23	15	25	2	8	3
59	F	34	18	18	15	18	11	18	3	7	3
60	M	48	15	15	15	15	9	15	3	9	3
61	M	15	18	15	18	15	11	15	3	8	4
62	M	18	18	18	15	18	11	18	2	7	3
63	F	20	22	18	22	18	15	18	3	9	3
64	F	40	23	23	23	23	16	23	3	9	3
65	F	46	25	25	18	25	18	23	3	9	7
66	M	42	20	22	20	22	13	22	2	8	3

Data for One Hundred Patients—Continued

Case No.	Sex	Age	Tension Before Instillation		Tension After 1 Hour		Tension After 24 Hours		Diameter of Pupil Before Instillation, Mm.	Diameter of Pupil After 1 Hour, Mm.	Diameter of Pupil After 24 Hours, Mm.
			Right	Left	Right	Left	Right	Left			
67	M	42	22	22	20	20	13	22	4	9	3
68	F	16	18	18	18	18	9	18	3	8	3
69	F	19	20	18	20	20	12	20	4	9	3
70	F	46	24	24	22	25	20	25	3	7	3
71	M	34	15	18	15	15	9	18	4	9	5
72	F	58	15	15	15	15	9	18	5	8	5
73	F	15	15	15	15	15	9	15	4	7	4
74	F	15	15	15	15	15	15	18	3	5	3
75	F	32	20	22	20	22	15	22	3	9	2
76	F	18	18	18	18	18	12	18	4	10	3
77	M	48	22	22	22	22	14	22	3	6	2
78	M	58	23	23	21	23	15	23	4	7	3
79	M	23	15	18	15	18	15	18	3	7	3
80	F	20	18	18	15	18	15	18	3	9	2
81	F	25	18	18	13	18	9	15	4	9	4
82	M	34	22	22	22	22	16	22	3	7	4
83	F	42	22	22	20	22	15	22	3	7	3
84	M	57	20	20	18	20	9	20	4	9	4
85	F	59	22	22	20	20	15	20	3	9	3
86	M	23	18	18	18	18	9	18	3	6	3
87	F	15	25	25	22	22	15	25	3	3	3
88	M	24	18	18	18	18	12	18	3	9	4
89	M	46	22	22	20	22	16	20	4	8	4
90	M	52	20	20	20	20	15	20	4	9	4
91	M	18	15	15	15	15	10	15	5	9	5
92	F	42	25	25	25	25	15	25	2	7	3
93	M	63	15	15	15	15	8	12	3	9	4
94	M	57	22	22	22	23	12	18	2	7	4
95	M	42	18	18	18	18	12	18	3	7	3
96	M	58	20	23	20	22	16	22	2	8	3
97	F	17	22	23	22	23	18	22	3	9	4
98	M	26	18	20	18	18	16	17	3	8	3
99	M	19	24	24	22	24	20	25	2	6	2
100	F	27	18	18	18	18	9	18	4	8	4

after one hour in 35 per cent of the cases, and in all of these except three (cases 14, 64 and 80) it became progressively greater within the subsequent twenty-four hours. The average drop for the first hour was 3 mm., and for the following twenty-four hours, 4 mm., with a total change of 7 mm., which is practically of the same degree as the drop noted in the first group of fifty-eight patients. In six instances the tension was unchanged, and in three a rise of a few millimeters preceded the final fall. There appeared to be no direct relation between the extent of reduction of tension and age or sex.

Observations on mydriasis were made only on the right eye. The pupil dilated within one hour in 98 per cent of the cases and had returned to normal size in twenty-four hours in 54 per cent. The increase in pupillary diameter varied from 1 to 7 mm., with an average of 4.6 mm. In nineteen cases the initial mydriasis was replaced by a mild miosis within twenty-four hours, whereas in 21 per cent, with an average primary increase of 5 mm., the pupil was still slightly dilated (1.3 mm.) after twenty-four hours. In only two instances (cases 6 and 87) did the pupil fail to dilate. The reason for this is not clear.

for the absorption of the drug was entirely adequate, as demonstrated by the reduction of tension.

Equally interesting are the changes noted in the opposite eye. The intra-ocular tension did not vary over the period of observation in 63 per cent of the cases. In eight cases a temporary fall of about 2 mm. occurred within one hour after the last instillation of epinephrine. In 17 per cent the tension was unaffected after one hour but at the end of twenty-four hours showed an average drop of 2.3 mm. A slight rise of tension after one hour, followed by a return to or slightly below the normal reading, occurred in four cases.

In case 30, that of a 39 year old woman, a mild reaction to epinephrine took place. Within a few minutes after the instillation of the

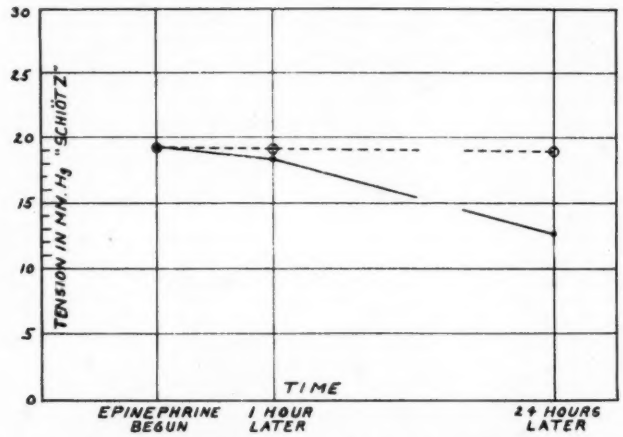

Chart showing the reduction of intra-ocular tension following the instillation of epinephrine solution (2 per cent) into the conjunctival sac of the right eye. The left eye was not treated. The solid line represents the tension in the right eye; the broken line, that in the left eye.

second drop of the drug, the patient became nervous and tremulous and complained of palpitation; her pulse rate rose from 82 to 120. After about ten minutes, however, these symptoms disappeared and did not recur, although she was later given several more drops of epinephrine.

CONCLUSIONS

The instillation of a 2 per cent solution of epinephrine into the conjunctival sac of the normal eye is usually, though not always, followed by a reduction in the intra-ocular tension. The drop in pressure may occur within one hour, but in most cases, it is not obtained until later.

A similar lowering of tension, though of much lesser degree, may be seen in the opposite eye.

Mydriasis usually occurs within one hour and disappears within twenty-four hours.

Following dilatation of the pupil of the normal eye, there is no tendency toward a sustained or material increase in the intra-ocular tension.

Absorption of epinephrine from the ocular conjunctiva may produce systemic effects in susceptible persons.

Solutions of epinephrine, since they do not produce an increase in intra-ocular tension, are a suitable mydriatic for use in studies of the fundus and media of eyes in which atropine or its derivatives might be dangerous.

DETACHMENT OF THE RETINA

TREATMENT WITH THE ELECTROLYSIS NEEDLE

PROF. A. VOGT
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In May 1934, I suggested a method of closing a hole in the retina by multiple momentary punctures with the electrolysis needle (cathode) in the margin of the hole and in the hole itself. The anode, a small ball, lies on the eyeball. This method is the most delicate and most successful operative procedure for detachment of the retina. Instead of extreme heat or sodium hydroxide solution, a current intensity of only from 0.5 to 1 ma. is necessary. The application is momentary and can be repeated many times until the hole has been completely treated.

This new operation does not produce cicatricial bands in the retina and secondary holes from too intense heat. In contradistinction to diathermy, cathode electrolysis is active at the point of the needle, and thereby avoids the danger of perforating the detached retina and producing new holes without cauterization. The formation of hydrogen bubbles at the place of puncture facilitates ophthalmoscopic control of the position of the puncture during the operation. The scars are delicate. Dozens of momentary punctures can be made without damage. Any electrolysis apparatus which is used in epilating cilia is sufficient, but the needle must be very fine. As no vitreous is lost, a number of holes and tears may be treated at the same sitting.

This method is not only unusually delicate, but quite efficient, and my results lead me to believe that it will rapidly replace the heating and alkali methods as well as diathermy.

In 1893 Schoeler made use of the electrolysis needle in the operative treatment of detachment of the retina, but did not pay any attention to the hole. The experimental surface electrolysis of von Szily and Machemar and their investigations on the action of the anode needle in animals have nothing to do with my method.

Read before the Swiss Ophthalmological Society, May 5, 1934, and the Society of Physicians of the Canton Zurich, July 3, 1934.

ORTHOPTIC AND SURGICAL MANAGEMENT OF STRABISMUS

REPORT OF SIXTY CASES

JOHN P. LORDAN, M.D.
LOS ANGELES

The cases reported in this series were seen over a period of three and one-half years. For the first six months the management consisted largely of surgical measures and occasional fusion development with Worth's amblyoscope. The need for more orthoptic training was obvious from the start. An attempt was made to teach one of the nurses working in the outpatient department to give the exercises, using the amblyoscope and the Keystone telebinocular. This was a much better plan, but still far from satisfactory. Finally a department was established where the work could be done thoroughly and the records kept by an assistant who had spent the past eleven years assisting an ophthalmologist. The orthoptic training has been carried on in that department for the ten months prior to writing, and the results have been much more satisfactory than before.

EXAMINING ROUTINE

Particular emphasis was placed on obtaining from the patient information in regard to the age at onset of the squint, whether or not glasses were worn, the amount of previous orthoptic training, any other forms of treatment and the effect of each on the deviation. In all cases either the patient or, if the patient was a child, the parents had the management of the case explained to them in detail. They were advised as to the need for glasses, when these were indicated, the importance of the orthoptic training and the usefulness of the indicated surgical measures. In the event of surgical procedure, the patient was told of the possibility of more than one operation being necessary, the fact that the tendons to be operated on were located on the outside of the eyeball and did not necessitate opening of the globe and other facts concerning the surgical technic. When possible, the patient was advised in advance to expect either a cosmetic or a good binocular functional result, as the case indicated. In practically every case these explanations made for a cooperative, satisfied patient.

From the Eye and Ear Hospital of Los Angeles.

Read at the Twelfth Annual Summer Graduate Course in Ophthalmology, Denver, July 24, 1934.

Pictures of the eyes were taken before and after the operative or orthoptic procedures were instituted. The refractive error, visual acuity and amount of fusion were determined. The ocular movements in all directions of both eyes together and of each eye individually were observed. External examination and study of the fundus were made according to routine.

DEVELOPMENT OF VISUAL PERCEPTION AND ORTHOPTIC TRAINING ROUTINE

In patients with amblyopic eyes an attempt was made to increase the visual acuity before the operative intervention. This group of patients consisted of those whose visual acuity with glasses could not be increased to 20/65. The usual methods of atropinization and covering the good eye and using the amblyopic eye while playing, eating meals, drawing pictures and cutting out paper dolls were employed. In the treatment given in the office the cards supplied in the Keystone series were used.

The orthoptic routine consisted of treatment in the office and home. When possible, the patients were seen in the office two or three times weekly for twenty minutes at a time. When it was not possible for patients to come to the office regularly, treatment was given in the home. In the office a Lloyd's slate equipped with rotary prisms, with which the Wells charts were used, the Keystone telebinocular and correct-eye scope and Worth's amblyoscope were employed. For treatment in the home, the Keystone correct-eye scope and Worth's amblyoscope or the stereoscope were given to the patient.

A record was made at the beginning of the treatment of the presence of diplopia and of first, second or third degree fusion. As the treatment progressed, the time of the onset of each of these was noted.

Patients having fusion in some degree were given fusion training preoperatively as well as postoperatively. Fusion was described as (1) first degree when, with the amblyoscope, the bird could be put in the cage or, with the Keystone split charts, the circle could be put in the square; (2) second degree when, on the Keystone split charts, the pictures could be superimposed and the cross seen, and (3) third degree when depth perception was appreciated.

SURGICAL TECHNIC

The patients were all hospitalized and usually entered the hospital on the day of operation. Children were operated on under general anesthesia, adults under local anesthesia. Local anesthesia was obtained with 6 drops of 4 per cent solution of cocaine administered at intervals of five minutes and also subconjunctival injection of 2 per cent procaine hydrochloride with epinephrine hydrochloride.

In the operation sodium-oxymercury-orthonitrophenolate (1:8,000) and saturated solution of boric acid were used for irrigation. A thin piece of rubber dam about 5 inches (12.7 cm.) square, with a hole cut near the center, was used, permitting the sewing of the cut edge of the hole to the jaws of the speculum. This prevented the contamination of the sutures and instruments by contact with the skin of the face. The technic of placing the strands of dermal suture material (000 medium) in the tendon to be shortened was performed as described by Dr. O'Connor [1] in 1930. There were variations in the number of strands of dermal suture used, the number varying from four to seven double strands. In the earlier operations in this series, seven double strands were used frequently. This made a cable of fourteen strands, which was difficult to handle. On the advice of Dr. O'Connor, this number was reduced to four doubled, or eight, strands. The manipulation of the cable was facilitated, with approximately the same amount of shortening effect. When only a small shortening was desired, as few as two or three strands were used.

Practically the same instruments were used in these cases as were described by Dr. O'Connor.

Tenotomy on the opposing tendon was performed in several different ways. In the charts it was described as follows: (1) partial tenotomy, in which the lateral borders of the tendon were completely freed and cut and a small nicking was made in the central portion of the tendon; (2) central tenotomy of two types, one as used by O'Connor and described by Stevens, in 1883, in which the center of the tendon was picked up and cut without displaying or freeing the rest of the tendon, the other as performed by Dr. George N. Hosford,[2] in which the tendon was placed on the flat hook and completely freed from connective tissue, and the desired amount of tenotomy was performed under direct vision; (3) guarded complete tenotomy, in which the tendon was freed and cut off completely, and a black silk stay suture was passed from the tendon to the stump and left so that the suture could be shortened or lengthened later, as indicated, and (4) complete tenotomy, in which the tendon was freed and cut off completely near the scleral attachment.

Usually, only the eye operated on was bandaged, and the dressing was changed the next day. The running black silk conjunctival closing suture was removed on the fifth day, if it had not already been washed out. In the first half of the cases the dermal suture was left in for

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1. O'Connor, R.: Tr. Pacific Coast Oto-Ophth. Soc., 1930, p. 52.

2. Hosford, G. N., and Hicks, A. M.: O'Connor Cinch Shortening Operation for Heterotropia and Heterophoria: A Critical Survey, Arch. Ophth. **11**:814 (May) 1934.

from fourteen to twenty-one days—usually for fourteen days. At present the dermal sutures are always left in for fourteen days. On the third or fourth postoperative day the orthoptic exercises were begun.

Dr. O'Connor assisted in perfecting his technic, and Dr. Simon Jesberg and other members of the staff of the Eye and Ear Hospital gave suggestions and help.

RESULTS

Table 1 shows the end-results of the management of sixty consecutive cases of strabismus by this method.

TABLE 1.—*End-Results of Management of Sixty Cases of Strabismus*

Type of Strabismus	Number of Patients	Number Obtaining Cosmetically Straight Eyes	Number Obtaining Fusion and Degree of Fusion			Number Failing to Obtain Fusion	Number in Which No Fusion Was Determined
			First	Second	Third		
Monocular convergent	40	39	4	8	15	2†	11
Monocular divergent	5	4	1	..	3	..	1
Alternating convergent	15	12	1	2	6	..	6
Total	60	55*	6	10	24	2	18

* The explanation for the failure in the case of the eyes not cosmetically straight is as follows: Patient 22 was advised to have the other eye operated on, but was satisfied with the result as it was. In patient 28, the general appearance was fair, although at times the left eye converged as much as 20 degrees (the notes on the operation stated that the external tendon of the left eye was thinner than usual). When patient 36 had glasses on the eyes were straight most of the time, but occasionally the right eye deviated outward and up (overcorrection). In case 54, which is described later, there was failure of the O'Connor cinch shortening. In case 59 there was a postoperative overcorrection of 30 degrees at first; the patient now has only 10 degrees of overcorrection, and is well pleased with the result.

† The explanation for the failure of the two patients who did not obtain fusion after receiving the fusion treatment is as follows: Patient 30 had no central vision in the right eye, and patient 53 had amblyopia in the right eye (the lower two thirds of the cornea being opaque). In the eighteen cases in which no determinations of fusion were made, a part of the patients failed to return after the eyes became cosmetically straight; in several of the cases the records were not carefully kept, and in the remainder the records of the fusion were lost.

In case 54 the attempt to shorten the external rectus muscle with the O'Connor suture failed. The patient previously had had an advancement of the external rectus muscle, at which time the surgeon stated in his notes on the operation that "the tendon was adherent to the eyeball back to and beyond the equator." At the present operation, the tendon was short but easily located; it was cleaned and placed on the hook, and the dermal shortening suture was put in place in the routine manner. When the attempt to apply traction on the dermal suture to straighten it was made, the two upper tendon strips were torn apart. The traction was immediately stopped, the suture unwound from the remaining two strips and a large tuck taken in the tendon and muscle tissue. Closer inspection revealed that the tendon was still firmly adherent to the globe and that about half the suture had been put in the muscle tissue and not entirely in tendon, thus accounting for the breaking of the first two strands.

Table 2 lists the results in twenty patients whose records were complete enough to demonstrate the progress of treatment. They were treated twice weekly in the office and daily at home. Five months was the average time of treatment. Many patients not included in this table obtained fusion, as noted in the first chart.

TABLE 2.—*Detailed Results of Orthoptic Training* *

Name of Patient	Age, Years	Type of Strabismus	Fusion Before Treatment	Time Elapsed Before Onset of Degree of Fusion, Days			Visual Acuity		Length of Time of Treatment, Months
				First	Second	Third	Before Treatment	After Treatment	
H. L.†	15	L. C.	.....	P. O.	P. O.	P. O.	20/24 20/65	20/24 20/49	5
K. H.	8	R. C.	None	P. O.	P. O.	210	20/49 20/49	20/49 20/49	7
W. F.	2½	R. C.	None	None	None	None	19/49 20/19	10/49 20/19	5
W. F.	2½	R. C.	None	None	None	None	10/49 20/30+	10/49 20/32	5
D. C.†	8	L. C.	Poor diplopia	22	82	Never	20/30 Fingers at 1 foot	20/19 20/65	3
R. C.†	12	L. C.	None	56	116	Never	20/30+ 20/200	20/19 20/98	4½
E. A.	12	L. C.	None	P. O.	18	138	20/24 20/24	20/19 20/19	5
E. D.	6½	L. C.	None	4	?	29	20/39 20/24	20/39 20/24	6
V. S.†	5	R. C.	None	30	240	Never	Fingers at 3 feet 20/39	20/65 20/24	8
H. E.†	18	L. C.	At first with effort	87	210	Never	20/19 20/196	20/19 20/65+	3
H. G.†	17	L. C.	None	9	58	120	20/19 20/65	20/19 20/39+	4
A. B.†	11	L. C.	None	18	33	83	20/24 20/196	20/24 20/49	3
T. C.	24	A. C.	None	P. O.; third degree with difficulty after 28 days with ease			20/19 20/19	20/19 20/19	1½
A. H.	6	A. C.	None	27	48	Never	20/30+ 20/30+	20/30+ 20/30+	5
M. J.	11	A. C.	None	P. O.	P. O.	P. O.	20/24 20/24	20/24 20/24	9
J. D.	6½	A. C.	None	10	44	110	20/24 20/20	20/20 20/20	5
M. H.	5	A. C.	None	45	?	Never	20/70 20/70	?	6
E. W.	12	A. C.	None	18	?	123	20/24 20/19	20/24 20/19	5
N. W.†	22	L. D.	None	16	Never	Never	20/19 20/196	20/19 20/98+	6
D. W.	21	L. D.	None	4	11	18	20/19 20/19	20/19 20/19	1

* The abbreviations are as follows: L. C., left convergent strabismus; R. C., right convergent strabismus; A. C., alternating convergent strabismus; L. D., left divergent strabismus, and P. O., postoperative.

† Patients with amblyopia whose visual acuity improved under treatment.

Seven of the twelve patients with monocular squint obtained third degree fusion, and four second degree fusion; in one, owing to absence of central vision, no fusion occurred. Four of those with alternating squint obtained third degree fusion, one second degree fusion and two first degree fusion. Of those with divergent squint, one acquired third degree fusion, the other first degree fusion.

It may be seen from table 3 that there were ninety-one operative procedures. In the cases of convergent and alternating strabismus about 1.5 operations, and in those of divergent strabismus, 2.5 operations, were employed to each patient. There were seventy-four O'Connor cinch shortenings, all of which were successful, except that in case 54, as has been noted.

Table 4 points out the frequency of operation on the other eye. When partial tenotomy was used, this was one time in seven; when central tenotomy was used, one time in two, and when guarded complete tenotomy was used, one time in seventeen; with complete tenotomy, the second eye was operated on one time in three. It may also be seen

TABLE 3.—*Number and Types of Operative Procedures*

Type of Strabismus	Number of Operative Procedures	Number of Operative Procedures per Patient	O'Connor Operation Combined with Tenotomy	O'Connor Operation Alone	Other Types of Shortening	Tenotomy Alone
Convergent.....	58	1.4	45	8	2	1
Divergent.....	12	2.4	5	..	..	..
Alternating.....	21	1.5	21	..	..	..
Total.....	91	1.8	71	3	2	1

TABLE 4.—*Types of Tenotomies and Results*

Type	Number	Cases Necessitating Operation on Other Eye	Overcorrection	Undercorrection
Partial.....	27	4	3	9
Central.....	21	9	..	1
Guarded complete.....	17	1	5	4
Complete.....	3	1	..	1

that with partial tenotomy the deviation was overcorrected in one case in nine and in the guarded complete group one time in three. With partial tenotomy, the deviation was undercorrected in one case in three; with central tenotomy, in one case in twenty-one; with guarded complete tenotomy, in one case in four, and with complete tenotomy, in one case in three.

It would seem from these figures that the tenotomy with the greatest safety and the least possibility of overcorrection or undercorrection is the central tenotomy, in spite of the necessity for operation on the other eye in every second patient.

SUMMARY AND CONCLUSIONS

1. Preoperative as well as postoperative records should be kept in detail. Photographs taken with the Leica camera before and after operation are valuable, and are useful in demonstrating end-results to the new patient considering surgical treatment.

2. Simple orthoptic and visual perception procedures systematically carried out are of assistance in treating strabismus. When the visual acuity is 20/49 or better, third degree fusion may be expected in almost all cases when the eyes are in, or near, parallelism. (The presence of third degree fusion, however, does not always allow the inference that the eyes are perfectly straight.) Second degree fusion may be present when the visual acuity is as bad as 20/65.

When amblyopia of 20/200 or more is present, vision can be increased to 20/65 within a few weeks, but further increase in the visual acuity takes months. In cases in which fusion development was undertaken, the average time of the onset of fusion was as follows: one month for first degree fusion, three months for second degree fusion and four months for third degree fusion.

3. The O'Connor technic proved very satisfactory. The operation did not necessitate a long period of disability, children usually not missing more than three or four days of school. There were seventy-one O'Connor cinch shortenings combined with one of the four types of tenotomies and three O'Connor cinch shortenings in which no tenotomy was performed. In no case was there any reaction of tissue or discomfiture of the patient which made it necessary to remove the dermal suture before the required number of days. As a general rule, a convergent squint with a deviation as great as 20 degrees can be corrected by using the cinch shortening and central tenotomy on one eye. For greater deviations, operation on the second eye will often be necessary. When the visual acuity in the amblyopic eye has not been or cannot be improved and the deviation is more than from 15 to 20 degrees, something more complete than central tenotomy will be necessary. Dr. O'Connor [1] advises complete subcapsular tenotomy as the preliminary procedure in such cases, and if the deviation is not straightened, the cinch shortening later.

4. The central tenotomy performed by placing the previously well cleaned tendon on the flat hook and cutting the central strands under direct vision gave the best results. It had the advantage in that convergence was not sacrificed at the expense of straightening, nor did overcorrection occur in any case, although both overcorrection and undercorrection occurred in the other types of tenotomy. The fact that one patient in two has an operation on the other eye cannot be considered a disadvantage, provided that the patient is warned of that probability beforehand.

ADENOCARCINOMA OF A MEIBOMIAN GLAND

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The first description of a tumor of a meibomian gland was given by Baldauf in 1870. He classified the tumor as an adenoma. Though Sourdille in 1894, Dor in 1896 and Axenfeld in 1895 and 1899 reported epitheliomas of the meibomian glands, von Michel as late as 1908, in the Graefe-Saemisch handbook, expressed his doubt of the existence of epithelioma and classified all tumors of the meibomian glands as adenomas. The casualness with which nearly all tumors of these glands were considered to be benign was later disturbed by Scheerer,[1] who in 1913, in a report of a case in which the growth was undoubtedly carcinomatous, stated that he considered malignancy to be much more common than had previously been suspected, an opinion which was based on a sharp critical survey and reclassification of the cases reported in the literature.

Scheer's justification for attempting to reclassify the reported cases becomes obvious when one considers, for example, the publication of Hesse in 1910, in which the author's diagnosis of an adenomatous tumor was contradicted by his accompanying description which gave evidence that the growth was definitely infiltrating.

Scheerer [1] collected and summarized the cases of Thiersch, Baldauf, Nettleship, Fuchs, Gosselin, de Vincentiis, Bock, Rumschewitsch, Allaire, Salzmann, de Schweinitz, Sourdille, Wadsworth, Dor, Gross, Knapp [2] (two cases), Scalinzi, Wood, Krompecher, Pause,[3] Monthus, Markbreiter, Snell, Grignolo,[4] Adamück (two cases), Gabrielidès,[5] Hesse and Smirnow, which with his own case totaled thirty-one.

He concluded that these thirty-one cases could be divided into two groups: fourteen of adenoma and seventeen of carcinoma. He found no difference in incidence between the sexes. Though cases in children were recorded (one of Knapp's [2] patients was 3½ years old), the majority of the patients were between the ages of 40 and 80, the

1. Scheerer, R.: Ueber die Geschwülste der Meibomschen Drüsen und über die Therapie der Lidgeschwülste im Allgemeinen, Stuttgart, F. Krais, 1913; Ein Beitrag zur Kenntnis der Geschwülste der Meibomschen Drüsen, Klin. Monatsbl. f. Augenh. **27**:86, 1914.

2. Knapp, H.: Roy. London Ophth. Hosp. Rep., October, 1903; abstr., Centralbl. f. prakt. Augenh. **27**:418 (Dec.) 1903.

3. Pause, G.: Kl. Monatsbl. f. Augenh. **43**:88, 1905.

4. Grignolo, F.: Jahresb. d. Ophth. **40**:565, 1909.

5. Gabrielidès: Arch. d'opht. **30**:178, 1910.

superior eyelid being the site of predilection. The growth in some cases took years and in others occurred within a few months.

Recurrence following extirpation was often recorded. In the cases of Adamück and Grignolo [4] exenteration of the orbit was necessary. In the cases of Snell and Thiersch the tumor led to death. Scheerer [1] suggested that the swelling of the preauricular lymph nodes reported to have occurred in some of the cases was due to inflammation (cases of Snell, Sourdille and Smirnow). He failed to lay stress on the extirpation of the parotid gland in Adamück's case. Reports of a few more cases not included by Scheerer had appeared in the literature; e. g., Grignolo [4] mentioned a second case, which was malign and necessitated exenteration of the orbit, and Cabannes [6] also reported a case. Although the aforementioned authors (with a few exceptions) claimed that the tumors originated in meibomian glands their accompanying descriptions, so far as they were available to me, do not justify the simple classification of Scheerer into adenoma and carcinoma: Thiersch spoke of a "polymorph epithelial growth," and Krompecher, of a "basal cell carcinoma"; in Sourdille's report cells resembling those found in Paget's disease were described; de Schweintiz found a "papilloma as occurs in cases of neglected chalazion" to have been a carcinoma of a meibomian gland. Sourdille, van Duyse [7] and others spoke of mucous degeneration. Other cases were probably not instances of meibomian gland tumors (Wood's case of a pigmented tumor and Markbreiter's case, which suggests inflammatory changes of the meibomian glands).

Following Scheerer's [1] study, reports of other cases have been published: Cavara,[8] who reported a case of tumor of the upper eyelid in a man 67 years old, mentioned cases described by Mills, Mastrostefano and Chaillous. Lazarescu [9] sent me reports of two typical cases published in Rumanian. Glavan reported a case of tumor of the upper eyelid in a man aged 59. He described cells with vacuolated protoplasm, lumens resembling the tubules of a gland and giant cells; many karyokinetic cells were seen. Glavan concluded that the growth was "a sebaceous epithelioma in an advanced stage of metaplasis." Elena Puscarin, who reported a case of tumor of the lower eyelid in a patient aged 62, described the tumor cells as loaded with fat. Kümmel [10] (no personal case) mentioned the cases of Tolstpuchow, Riva, Pereira,

6. Cabannes and Lafon: Arch. d'opht. **26**:422, 1906.

7. van Duyse: Arch, d'opht. **34**:355, 1914.

8. Cavara: Zentralbl. f. d. ges. Ophth. **3**:570, 1920.

9. Lazarescu: Brit. J. Ophth. **14**:588, 1930.

10. Kümmel, cited by Lider, in Henke, F., and Lubarsch, O.: Handbuch der speziellen pathologischen Anatomie und Histologie, Berlin, Julius Springer, 1931, vol. 11, pt. 2.

Létulle and de Lapersonne [11] (tumor of the lower eyelid in a man aged 62), van Duyse [7] (tumor of the lower eyelid in a man aged 60) and Marri (tumor of the lower eyelid in a patient aged 60). Shohi [12] reported a case of tumor of the lower eyelid in a woman aged 69 and briefly described cases reported by Komoto (tumor of the lower eyelid in a man aged 59), Inatomi (tumor of the upper eyelid in a man aged 35), Yataka (tumor of the upper eyelid in a man aged 68), Akia (tumor of the upper eyelid in a man aged 40), Masuda (tumor of the upper eyelid in a man aged 69), Schioda (tumor of the upper eyelid in a man aged 47), Matsumoto (tumor of the uper eyelid in a man aged 44) and Kitabori (tumor of the lower eyelid in a man aged 59). The growth in the case of Komoto, clinically malignant, was stated merely to be an adenomatous carcinoma. Imatoni's tumor, described as being built up of pavement cells and growing from the duct of the gland, was of a special variety not described before. Knapp [2] (original article not available to me) reported several cases. Michail [13] (no personal case) described a case observed by Richet. Parsons [14] (no personal case) mentioned cases reported by Scott and Griffith, and Panas; Morax,[15] cited a case observed by Regaud-Monad, and Sattler, one reported by Purtscher.

Exenteration of the orbit was necessary in the cases of Knapp,[2] Shohi,[12] Komoto, Cavara, Regaud-Monod and Purtscher, the two cases of Scheerer and the case of Grignolo (nine in all). Knapp and Cavara each reported a fatal outcome, Scheerer mentioned two deaths, and Riva (the original article was not available to me) five; so probably more fatal cases have been described. Involvement of the preauricular glands was seldom noticed (Cavara [8]); previous trachoma was reported only by Cavara. Alterations of the conjunctiva were reported to have been present in several of the cases described by Scheerer (those of Thiersch, Bock, Sourdille,[5] Krompecher, Pause [3] [probably a case of adenoma] and Gabrielidès [5]); later they were reported by van Duyse,[7] Létulle and de Lapersonne [11] and Cabannes.[6]

These cases, including my own, make a total of over sixty. The statements of Scheerer as to age, sex, localization and malignancy are supported by these new cases. It is remarkable that more recently authors seldom make a diagnosis of adenoma but nearly always of epithelioma, even when there is no evidence of malignancy present. Morax [15] went so far as to state, in 1926, that it is not possible to

11. Létulle and de Lapersonne: Arch. d'opht. **40**:641, 1923.

12. Shohi: Arch. d'opht. **46**:144, 1929.

13. Michail: Ann. d'ocul. **161**:817, 1924.

14. Parsons, J. H.: The Pathology of the Eye, London, Hodder & Stoughton, 1904, vol. 1, p. 26.

15. Morax: Cancer de l'appareil visuel, Paris, Gaston Doin, 1926, p. 101.

distinguish, even histologically, between an adenoma and a carcinoma of a meibomian gland, and labeled all such tumors epithelioma, as van Duyse did. In view of this more recent attitude of many investigators on the subject of malignancy of these tumors it is somewhat surprising to find that Schreiber,[16] in 1924, in the latest edition of the Graefe-Saemisch handbook, in his revision of the chapter on the eyelids originally written by von Michel, still expressed doubt as to the existence of carcinoma of the meibomian glands. The world-wide reputation that this handbook enjoys gives weight to such an opinion, which probably influences countless practitioners. From my study of the literature I am of the opinion that though many points can be gathered from the reported cases which can be used as strong arguments in supporting a diagnosis of epithelioma or adenoma of a meibomian gland the histologic descriptions in the reports are not always clear enough to allow a differential diagnosis to be made between a malignant and a nonmalignant growth.

The tendency of recent investigators to consider all tumors of the meibomian glands as malignant is, however, too extreme, and I agree with Kümmel [10] that one should be able to distinguish between adenoma and carcinoma.

A few related conditions should be mentioned briefly here:

Michail [13] described an interesting case of an adenoma of the sebaceous glands of Zeiss. The tumor developed at the margin of the superior eyelid in a man of 67. In discussing such tumors, Michail said: "In proliferating these sebaceous tumors generally show a regressive metaplasia of epidermoid aspect." Rumschewitz also described an adenoma of sebaceous glands; von Michel described multiple adenomas, and Schreiber,[16] an adenoma of the caruncle.

Tumors of the mamma, an organ derived from sebaceous glands, are widely discussed in works on general pathology and are of interest because of certain features analogous with those of the tumor of a meibomian gland which I shall describe. In contradistinction to this, the simple sebaceous glands of the skin, which are more closely related to the meibomian glands, do not show a tendency to blastomatous growth, and therefore the literature on this subject is meager. Such leading pathologists as Unna and Darier have denied the existence of true adenoma and carcinoma of the sebaceous glands, and in a survey of the reports appearing in the dermatologic literature Carol,[17] in 1921,

16. Schreiber, L.: Die Krankheiten der Augenlider, in Saemisch, T.: Handbuch der gesamten Augenheilkunde, ed. 3, Leipzig, Wilhelm Engelmann, 1924, pp. 315 and 407; Arch. f. Ophth. **84**:429, 1913.

17. Carol: Acta dermat.-venereol. **2**:199, 1921.

and van der Valk [18a] concluded that no definite sebaceous adenoma or carcinoma had been described. Van der Valk stated:

> If we exclude hyperplasia and hypertrophia of sebaceous glands (acne rosacea, rhinophyma, senile hyperplasia), haematoma and nevi (congenital malformations) in tuberous sclerosis and naevus sebaceus Jadassohn, there remains only adenoma cystica of Brooke, a special form of the well known carcinoma basocellulare of Krompecher. This disease in its solitary form is extremely rare, cases of Bock (1880), Reitmann (1909) and Balzer (1885).

Darier reported a case observed by van der Valk [18a] of "adénome sébacé ou épithéliome sébacé." Darier,[18b] in his discussion, said: "I have created *la rubrique des adénomes sébacés, progressifs* and thus endeavor to introduce these tumors within the circle of many other nevi of different nature that are likewise progressive growths." Darier extended his conception of a "nevus" to certain macules (growths analogous to congenital nevi) that develop on the skin in adult life or in the senium. Obviously Darier did not demand the presence of nevus cells for the diagnosis of nevus. His conception of a nevus (and that of some other dermatologists) differs from that of other authors. The tumor observed by van der Valk was considered to be a nevus by Carol also on account of the termination of some of the sebaceous glands directly at the surface, a condition which is never found under normal conditions in the skin of the face.

Ewing [19] the general pathologist stated, under the heading "adenoma sebaceum:"

> In the sebaceous glands there is a form of overgrowth, attended by oversecretion, and marked hypertrophy and multiplication of glands which may approach a neoplastic grade (Balzer, Menetrier). The disease occurs chiefly in epileptics and mental defectives and is usually limited to the skin of the face. In some cases the long duration, diffuse distribution, the orderly character of the cell-growth, and the self-limitation indicate a form of functional overgrowth (Caspary's case). Here there is extensive multiplication of large sebaceous glands and proliferation of the cells of the hair follicles. The epidermis may be thickened and the small vessels dilated. In other cases there is extensive hyperplasia of the gland-cells and the lesion resembles a reticulated epithelioma, or adenoma of sebaceous and hair follicles (Barlow). While usually self-limiting these lesions are doubtless the source of some multiple epitheliomas of the skin.

One may conclude that if real solitary adenomas (or carcinomas) of sebaceous glands have been described they are undoubtedly rare, and I do not believe that their study will aid in analyzing or classifying the tumor that I am about to report.

Létulle and de Lapersonne [11] expressed the belief their tumor developed simultaneously from a meibomian gland and from the con-

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18. (*a*) van der Valk, J. W.: Bull. Assoc. franç. p. l'étude du cancer **13**:465, 1924. (*b*) Darier, in discussion on van der Valk.[18]

19. Ewing, J.: Neoplastic Diseases, Philadelphia, W. B. Saunders Company, 1928.

junctiva. In the case of van Duyse,[7] probably similar to this one, the conjunctival epithelium was described as being in a state of reactive hyperplasia. Involvement of the conjunctiva was mentioned in several of the case reports collected by Scheerer [1] (those of Thiersch, Bock, Sourdille, Krompecher, Gabrielidès [5]). Whether such a condition is a simple reaction to the pathologic condition of the meibomian gland cannot be judged. It is not impossible that some of these cases were instances of malignant degeneration of a congenital malformation (nevus in the sense of Darier).

REPORT OF A CASE

History.—A man, aged 66, presented a tumor (fig. 1) on the temporal side of the left superior eyelid, which he first noticed two years prior to coming to the clinic. The skin covering the tumor had a yellowish tint and was free except for a loose attachment at one point. The tumor was about the size of a bean,

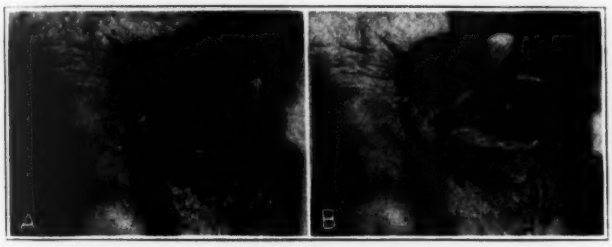

Fig. 1.—*A* shows a tumor of the left superior eyelid simulating a huge chalazion; *B*, the conjunctival aspect of the tumor.

lobulated and resilient on palpation. The conjunctival epithelium overlying the growth seemed destroyed, exposing a "bacon-like" yellowish surface with small gray nodules.

A small lymph node was felt in front of the ear. The tumor was considered malignant and removed radically, with plastic restoration of the eyelid (fig. 2). There was never a local return. Four years later the patient was operated on in a general surgical clinic for a tumor of the parotid region; at the same time several supraclavicular nodes were excised. In a comparative study of the specimens a similar structure was found in all three. Evidently the tumor was primary in the eyelid with metastasis to the parotid and clavicular glands. The patient died four months after the operation.

Macroscopic Aspects (Fig. 3).—The sections showed giant acini, from twenty to forty times the size of normal acini of the meibomian glands, large and small cysts, massive islands of cells and an apparently structureless infiltrative growth in the part of the tumor lying under the conjunctiva. Consequently the eyelid was thickened considerably, even in a direction anterior and inferior to the margin of the eyelid, so that the margin was no longer the most inferior part of the eyelid but lay on the posterior, conjunctival side. It was indicated by a slight inward retraction, giving to certain sections a rather typical aspect. In figure 3 at this point a meibomian duct filled with tumor cells is visible.

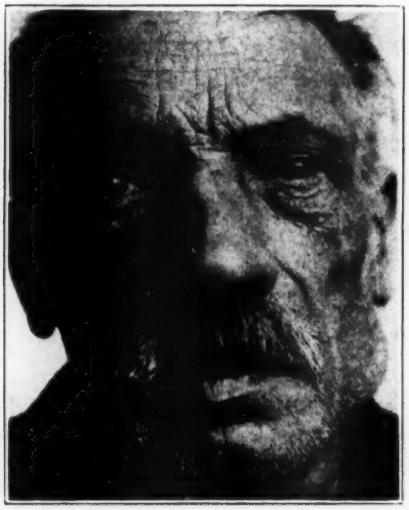

Fig. 2.—A photograph of the patient taken four years after extirpation of the tumor, showing plastic restoration of the eyelid and a metastasis in the inferior parotid region.

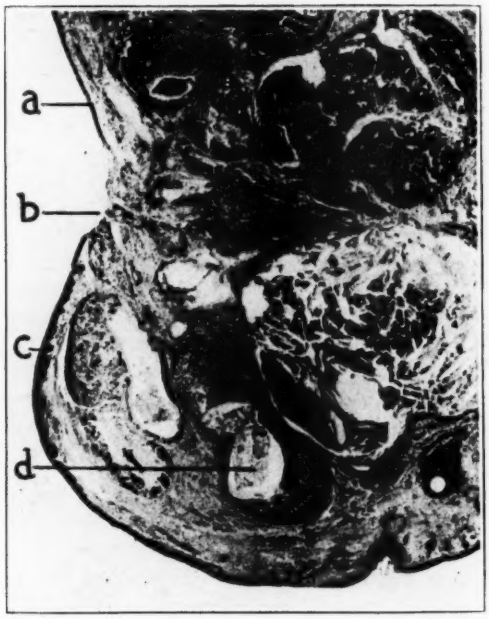

Fig. 3.—View under low magnification of a section taken through part of the tumor in the region of the margin of the eyelid, showing conjunctival epithelium at *a*, ducts of the meibomian gland filled with tumor cells at *b*, epithelium of the skin of the eyelid at *c* and a giant acinus at *d*.

Histologic Aspects (Figs. 4 and 5).—Epithelial cells having, in the main, a cylindric shape were arranged perpendicularly on a thin membrane of connective tissue which contained an occasional long, thin, deeply staining nucleus. Some of these rows of cells reached a length of one hundred or more cells. The nuclei were oblong or round, possessing a reticulated structure and two or more sharply demarcated nucleoli. The protoplasm was, on the whole, homogeneous, but here and there it showed a fine reticular structure. The protoplasm was more abundant in the region of the basal membrane, the cells in this area often showing a mass of protoplasm exceeding one half of the length of the nucleus. Above this layer of "sebaceous mother cells" there occurred in certain areas a second such layer, the cells of which, however, were less regular and had paler, though definite, nuclei. Extending over this single or double row of mother sebaceous cells, appeared layers of sebaceous cells some of which reached a height of twenty

Fig. 4.—View under medium magnification of a section showing papilloma-like growth of the tumor in a cyst, pseudotubulous glands (shrinking of the connective tissue frame) and sebaceous mother cells (at *a*).

or more cells. This band of cells crudely resembled normal sebaceous cells, though on the whole they were smaller, possessed larger nuclei and were not arranged with quite the exact mosaic nicety of the normal cells (occasionally, however, an apparently normal sebaceous cell was seen). Their protoplasm became more reticular the higher the layers went and contained in the upper layers small, apparently empty spaces. Within certain cells these spaces became more numerous and fused so that the protoplasm disappeared entirely, giving to the cell an appearance of being empty except for the remaining nucleus. When the frozen sections were colored with sudan III it became evident that these "cavities" contained alcohol-soluble fat; under polarized light numerous minute light crosses were seen, indicating the presence of cholesterol. Further chemical tests to identify the fatty substances concerned were not made. If hereafter I

speak of "fat" I indicate the presence of fatty substances giving the typical reaction to sudan III, though generally at the same time double-breaking fat (cholesterol) was present.

The picture of this "band of cells" (sebaceous cells and mother cells) should be kept in mind while studying other features of the tumor, as it was the basic architectural feature of many more complicated areas.

Vessels and slender septums of connective tissue within the tumor were often covered with these bands of cells. Where the connective tissue had shrunk, a tubular gland was sometimes simulated. Here and there the cylindric cells were grouped around a lumen that was far too large for a vessel and showed no vessel wall or lining endothelium and no shrunken mass of connective tissue.

Fig. 5.—View under high magnification of a cross-section through a pseudotubulous gland, showing sebaceous mother cells arranged around the lumen, surrounded by a mass of sebaceous cells.

These bands of cells were at times folded closely together, forming large massive islands of crowded cells within the tumor. Often the bands were not so typical as those previously described, though the same underlying architecture could be traced.

In the "giant acini" the sebaceous mother cells usually covered about three fourths of the connective tissue wall bounding the acinus, the rest of the wall being free or covered by less typical cells. The layer of sebaceous mother cells in such an acinus generally had a thickness of but one cell; these cells were more nearly cubic and contained less protoplasm than those in the bands of cells. The sebaceous cells, however, were numerous and composed two thirds of the thickness of the acinus; the remaining one third, the lumen, was empty or filled

with a poorly staining amorphous mass containing a few cells and needle-shaped empty spaces. It was placed eccentrically, one of its borders being formed by the free connective tissue wall of the acinus, which was occasionally covered by a single layer of cells. Frozen sections showed that the lumens of these acini contained fat (cholesterol) and fatty acids (needle-shaped spaces), which were affected by the alcohol used in fixing; this gave to the ordinary sections the appearance described. Certain acini became so distended by the continuous growth of their cells that degeneration of the marginal cells of the lumen set in and a cyst resulted.

Lying between the fat and crystals there were occasional islands of tumor cells and at times real giant cells, such as are found in fat phagocytosis. A comparable process is met with in the fat phagocytosis of ruptured atheromatous cysts.

Some of the larger cysts were secondarily invaded by tumor cells which arranged themselves in a more or less regular fashion on a widely ramified frame of connective tissue springing from the cyst wall. Above such a mass of cells a number of cell disks could be seen, apparently lying free within the lumen (fig. 4). These disks possessed lumens which were filled with a thin fibrous tissue. The Mallory staining of the sections revealed the framework of connective tissue and at the same time indicated that the slender tissue within the lumens of the cell disks must be the shrunken connective tissue frame of a transversely cut band of cells arranged around a frame of connective tissue. This behavior of the tumor cells reminds one of that in papilloma intracanaliculare of the mamma, though the connective tissue frame is much stouter in that condition and the tumor cells are less abundant.

The appearance of the tumor was evidently due in part to the characteristics of the tumor cells themselves and in part to the medium in which they grew. Thus in the portion of the tumor developing in the subconjunctival tissue the cell bands were much thinner than usual and had no such regular structure as was observed in other areas; this difference, however, was perhaps due partly to a more malignant character of this evidently younger part of the tumor. The cell islands in this region were much smaller and often contained fatty substances in the center. The cell bands generally lay parallel to the surface and aroused suspicion of their being carcinomatous cells, infiltratingly growing though rarely showing mitosis. Not infrequently these cell bands grew perpendicularly toward and even into the conjunctival epithelium. As far as I can judge, there was always a possibility of a definite separation between the conjunctival epithelium and the tumor cells, though the oblique sections were often misleading, giving an impression that the tumor originated from the conjunctival epithelium. At first glance one would be inclined to believe that there were "giant glands" (fig. 6) arising from the conjunctival epithelium. I could never prove, however, that such glands developed directly from the conjunctiva. They could always be traced to and be found continuous with the tumor. Professor de Vries, professor of pathology in Amsterdam, who examined my sections, rejected the idea of a separate growth developing from the conjunctiva as Létulle and Lapersonne [11] suggested in regard to their tumor.

The sebaceous mother cells and sebaceous cells were, however, only one of the two chief constituents of the tumor. The description just given is not complete. The scene was complicated by another type of cell, containing a long, darkly staining nucleus (fig. 7). These cells apparently grew between the sebaceous cells, often arranged in goose-step fashion or grouped into large streams

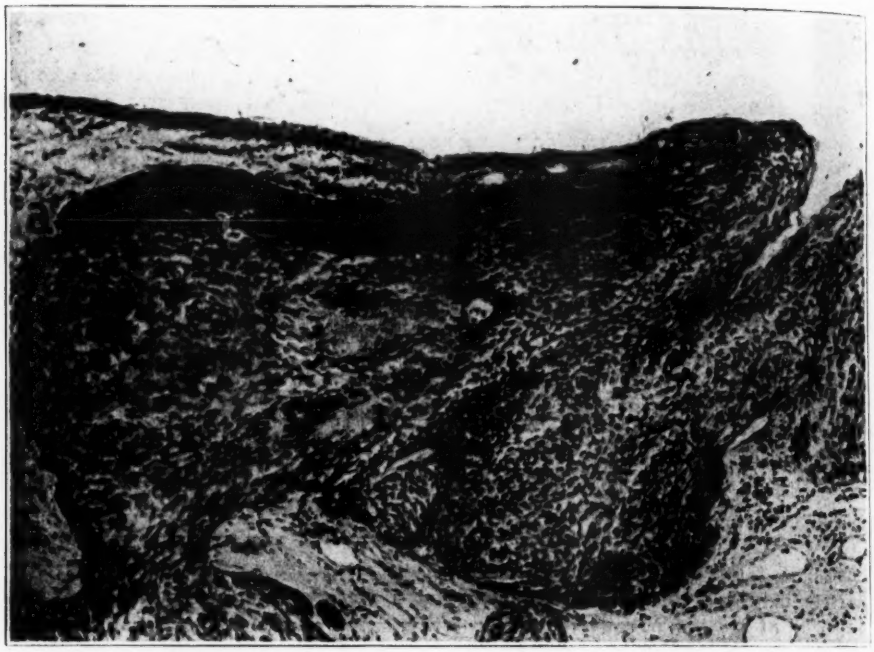

Fig. 6.—Section showing growth apparently originating from the conjunctiva, but continuous with the tumor. Pavement epithelium cells are indicated by *a*.

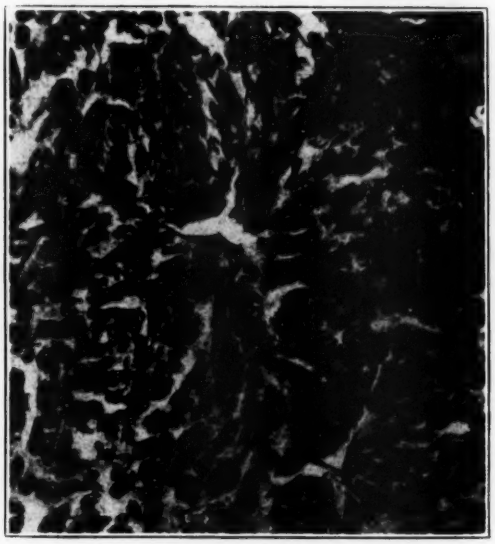

Fig. 7.—Section of the massive part of the tumor, showing an irregular mass of pavement epithelial cells (longer, thin, dark-staining nuclei) and sebaceous cells (oblong or round, less intensely staining nuclei).

Fig. 8.—Section from a metastasis in a supraclavicular gland. Sudan III stain; low magnification.

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of a thickness of many cells (fig. 7). The protoplasm was usually not visible. They resembled fibroblasts or epithelioid cells. Here and there it was difficult to judge whether a certain nucleus was one of connective tissue or one of the parenchyma of the tumor. The Mallory stain showed that these cells were never accompanied by fibers of connective tissue and had no relation with the small vessels within the tumor. The true nature of the cells was made clear by their concentric arrangement in certain (rare) areas—the typical onion-like appearance of an ordinary epithelioma. In the original tumor, however, very few such areas could be found (they were more frequent in the metastases). Other stains showed that the amorphous centers of these concentrically built up structures occasionally were horny but more frequently contained keratohyalin. Further staining revealed keratohyalin in many places, sometimes present in the form of numerous minute, darkly colored granules, as it is seen in the surface ectoderm (physiologic keratohyalin), or present in much larger pieces having an irregular shape (pathologic keratohyalin). If not especially on one's guard, one could easily overlook these small isolated patches of horn and the keratohyalin-producing cells scattered in the mass of fat-producing cells. Evidently this second type of cell was epithelial, being closely related to the pavement epithelial cells, just as the first described type of cell was related to the sebaceous cells.

In carefully reviewing the sections with the knowledge of the existence of these two types of cells one is struck by the mixed nature of this tumor, which on first inspection I totally overlooked, though I was puzzled at that time by the streams of "epithelioid cells." In some places there were small islands of prickle cells; and in other places, lying amidst abundant tumor sebaceous cells, there were small groups of from one to four or more cells containing keratohyalin within their protoplasm, while a few microns farther one observed almost typical sebaceous cells.

The larger cysts of the tumor have been described. Small cysts were present also, especially in the conjunctival part of the tumor. They were equal in size to from twenty to forty cells and were filled with fat, though horn and keratohyalin were sometimes found within the same cyst.

I must not close this description without emphasizing that the sebaceous tumor cell dominated the picture.

The secondary pathologic changes were insignificant. Small areas of poorly staining cells (necrosis) were extremely rare, and signs of inflammation did not interfere with the histologic picture of the tumor, as they were nowhere important.

The tumor invading the normal meibomian acini grew along their connective tissue walls, so that here and there islands of normal meibomian cells were surrounded by tumor cells. Occasionally a meibomian duct was filled with tumor cells. A perforation of the connective tissue which limits the normal meibomian gland was seen at but one place and caused a perforation in the direction of the skin.

The tumor contained neither mucus nor chalk; glycogen, however, was richly present.

Metastases (Fig. 8).—The metastases showed an astonishing production of fatty substances. The youngest proliferations of tumor cells within the lymph nodes and even the karyokinetic cells were crowded with fat. Usually the nuclei seemed to lie somewhat farther apart than in the original tumor, the intermediary spaces being filled with fat. The regularly arranged, cylindric mother sebaceous cells with their abundant protoplasm were absent here. The tumor cell either was a sebaceous cell, even when in karyokinesis richly loaded with fat, or, when

no fat is present, was nearly always of the pavement epithelium cell group (prickle cells, keratohyalin-containing cells, onion-skin-like cells). Cysts, as present in the original tumor, were not observed. Areas of pavement epithelium (prickle cells) were much easier to detect, since in the metastases the sebaceous cells contained little protoplasma and much fat, and the latter was dissolved by the ordinary methods of fixing, allowing the areas of prickle cells with their clearly staining protoplasm to stand out (pseudocartilage).

Some heaps of cells showed a central or eccentrically situated hole filled with fatty substances. Pavement epithelium and its products were much more common in the metastases than in the original tumor. Bizarre growths resulted from the activity of both types of cells in the same area, and fatty necrosis played a greater rôle than in the original tumor. For instance, at one point there was an oval area composed of concentrically arranged epithelial cells, which although much larger resembled a horn pearl. Toward the center the layers of epithelial cells became more compact, the nuclei lay closer together, karyorrhexis developed and one could see concentrically arranged streams of long, thin rests of epithelial nuclei. In the cell-free center of these dense concentric layers, however, not horn but fat was found.

CLASSIFICATION OF THE TUMOR

There was noted a systematic metamorphosis of sebaceous mother cells into sebaceous cells. Such a process, if found to be generalized, would induce one to make the diagnosis of a sebaceous adenoma. The fact that the structure of the tumor cells differed a little from that of the normal sebaceous cells does not affect such a diagnosis, since this is the case in adenomas generally. The production of fat in this tumor may be regarded from the same point of view as the secretions of other adenomas: an imitation of the function of the related normal cells, in this case the sebaceous cells. Although fatty degeneration of epithelial cells in other tumors is common, I do not believe that such a degeneration could explain the process in this growth. The cells clogged with fat showed no other signs of degeneration or necrosis and appeared healthy, even in the massive cell heaps. Except within the cysts definite areas of necrosis were rare. Finally, the regular arrangement of the cells and the fact that even karyokinetic cells clogged with fat appeared in the metastasis make the diagnosis of generalized fatty degeneration highly improbable.

A second strong argument for the diagnosis of adenoma is found in the regular arrangement of sebaceous mother cells and sebaceous cells occurring in the bands of cells. The absence of ducts does not affect such a diagnosis, since ducts are often absent in adenomas.

However, the small islands of pavement cells and the few horn pearl-like structures and keratohyalin-producing cells clearly established the mixed nature of the tumor, which is irreconcilable with a diagnosis of adenoma. The growth must therefore have been a carcinoma.

A mixed nature is by no means uncommon for a carcinoma. Certain malignant pavement cell growths of the nose and sinuses contain beaker

cells. Professor de Vries showed me sections from a pavement cell carcinoma of the mamma which contained a few isolated sebaceous cells but presented practically the opposite appearance from my tumor. Such a mixed nature is characteristic of malignant growths.

From the foregoing data there is sufficient evidence that the tumor described must have had a relation to a meibomian gland or have developed from a group of cells closely related to the embryonic cells from which the normal meibomian glands develop. It is improbable that it developed from other sebaceous glands in the eyelid, as such sebaceous tumors have not been described elsewhere in the body. As more than sixty similar tumors in the eyelid have been reported, it is evident that they must have a relation to an organ specific for the eyelid: the meibomian gland.

There exists sufficient evidence to call this growth a sebaceous adenocarcinoma of a meibomian gland, a tumor specific for the eyelid.

Another type of epithelioma of a meibomian gland can, theoretically, also exist, developing from the cells of the ducts. Such a tumor would be nonsebaceous, resembling of course the cells of its origin. There may even be arguments for considering that a pavement cell carcinoma may be related to a meibomian gland (Imatoni's case).

The diagnosis of a tumor of a meibomian gland originally depended on the simple criterion of the presence or absence of giant acini. In my case, the metastases as well as the portion of the tumor under the conjunctiva did not show these giant acini; therefore, I am convinced that this typical aspect of meibomian gland tumors is an adjustment of the tumor to the shape of the normal meibomian acini. The tumor cells follow a path outlined by the normal structure of the gland and therefore assume its shape. The dense tarsal structure resists infiltration and dams up the growth within the normal gland so that it becomes choked with tumor cells and secondarily distended. Recently Broders published a study of cases of "carcinoma in situ." Some time ago I saw such a case of a pavement cell carcinoma which had invaded a meibomian gland. Superficially studied and on the basis of the usual criterion, it might easily have passed for a carcinoma of the meibomian gland. This tumor will be described later.

In addition, the sudan III test for detecting the presence of fatty substances has been applied by only a few of the recent investigators. (Létulle and de Lapersonne[11] and the Japanese authors). The possibility of differential diagnosis of the tumors under discussion that this test has brought makes one doubt whether all of the published cases were really instances of sebaceous tumors of the meibomian glands.

Since in my case there was no evidence of any enlargement or abnormality of the neighboring meibomian glands (these were extirpated at the time of operation), it is not probable that the tumor grew from

a nevus. However, the tumor had grown too large to exclude definitely such a possibility. The peculiar aspect of the tumor in the region of the conjunctiva has been described previously and recalls the cases of Létulle and de Lapersonne [11] and van Duyse.[7] Létulle and Lapersonne believed their tumor to have developed simultaneously from a meibomian gland and the conjunctiva. In the case of van Duyse, probably similar to this, the conjunctival epithelium was described as being in a state of reactive hyperplasia.

Du côté de la conjonctive les lobules épithéliaux ont provoqué une prolifération atypique de Friedländer: papilles allongées, dichotomiques, disposition concentrique centrale (globe épidermique) dans l'une d'elles. En plusieurs points de la conjonctive on relève le contact, la fusion de son épithèle avec celui de la tumeur, fusion discrète qui ne sourait légitimer en rien l'hypothèse d'une origine aux dépens de ce même épithèle adulte.

[On the side of the conjunctiva the epithelial lobules have provoked an atypical proliferation of the Friedländer type: elongated, dichotomic papillae, with a concentric distribution (epidermal globe) in one of them. At several points on the conjunctiva there is contact by fusion of its epithelium with that of the tumor, a mild fusion which in no way justifies the hypothesis of an origin in this adult epithelium.]

There was no statement as to whether these outgrowths contained cholesterol. The presence of fatty substances would not, however, prove a rèlation with the tumor, since according to several investigators sebaceous cells may grow directly from the surface epithelium. These statements are of special interest with respect to the possibility that these tumors are nevi, and, on the other hand, with respect to a possible relation to certain growths of the mamma which develop simultaneously from the surface and from the gland itself.

In future cases, therefore, special attention should be paid to the aspect of the conjunctiva and of the adjoining meibomian glands.

In far advanced cases such finer study is impossible, and there exists no way of judging whether the tumor originally developed as an adenoma and only secondarily degenerated into an epithelioma. According to Ewing,[19] sebaceous cysts and papillomas occur chiefly about the nipple and may be a source of carcinoma. I believe that there may possibly exist some parallelism between these cysts and papillomas of the nipple and certain features of the tumors of the meibomian glands.

The histologic aspect of the preauricular tumor and of the tumor of lymph glands in my case resembled that of the tumor of the eyelid. All three growths consisted chiefly of sebaceous cells intermingled with pavement epithelial cells.

There were, however, slight differences in the secondary growths. There was almost complete absence of sebaceous mother cells and of the regular adenoma-like arrangement of cells, and there occurred bizarre formations of a mixed nature and more mitosis, which con-

stitutes a decidedly more malignant picture. These differences do not, however, disprove the evidence that the secondary growths were metastases from the tumor of the eyelid, since even more important differences between the original tumor and its metastases are often seen. Lubarsch described an adenomatous epithelioma of the stomach which caused lymph gland metastases of horn-producing pavement epithelium.

DIAGNOSIS, FREQUENCY AND MALIGNANCY

The appearance of such a tumor in the first stage of its existence has nearly always been reported as resembling a chalazion, differential diagnosis being nearly impossible. The unsatisfactory response to ordinary treatment usually awakens suspicion. Benign adenoma might, however, be commoner than one is accustomed to think. Parsons, as early as 1904, made the following comment on its frequency:

> Meibomian adenomata are possibly commoner than the literature would lead us to expect. It is not unusual to meet with chalazia which are hard and do not respond to the usual treatment. It is possible that some of these are really adenomata.

But even when the tumor is a definite epithelioma having already involved the preauricular and supraclavicular glands, the diagnosis may be easily missed, even at autopsy, as the history of my case shows clearly. The tumor of my patient was widely excised since there was clinical suspicion of malignancy. A plastic operation was done to restore the eyelid. The slightly enlarged gland in front of the ear was noticed, but the enlargement was considered to be probably inflammatory, instances of such a condition having been reported in the literature. Suspicion arose when Professor Zeeman learned that the patient had been operated on in the general surgical clinic for a mixed tumor of the parotid gland. Professor Zeeman suggested the possibility that this tumor was a metastasis from the tumor of the eyelid. The pathologist of the surgical clinic answered that the tumor could not possibly have any connection with the tumor of the eyelid. Only at the insistence of Professor Zeeman was a comparative study made of the three specimens, which brought to light the true state of affairs. The pathologist of the surgical clinic, one of the most experienced specialists on tumors in Holland, changed his diagnosis and stated that he had never met with a similar case.

It is instructive to note here that the holes and the peculiar aspect of the protoplasm of most of the cells seen in the microscopic sections of the metastasis in the parotid region were originally considered to be due either to shrinking or to edema. Only the frozen sections showed that they had been originally filled with fatty substances. I made the opposite mistake in studying my cases of "carcinoma in situ."

In this case I explained such spaces as being due to the fixing process by which the alcohol had dissolved the fatty substances; after applying the sudan III test to the frozen sections, however, not a single drop of fat proved to be present. Of course, a positive reaction is not an argument per se for a primary sebaceous epithelioma of a meibomian gland, since fatty degeneration of tumor cells is notoriously common. It is clear from the foregoing, however, that a highly positive reaction such as occurred in this case facilitates the diagnosis considerably.

If my associates and I had not heard of the subsequent operation we probably should have labeled the tumor adenoma (Graefe-Saemisch handbook), should have considered the preauricular gland to be inflammatory and should not have thought it necessary to spend so much time on its minute histologic examination.

Further, it is well known that occasionally the original tumor may remain relatively small while a metastasis grows continuously. Therefore, a small "chalazion" coexistent with a tumor of the parotid region should not be regarded as innocent until proved so. In such cases the pathologist should give special attention to the microscopic examination of the growths (including the "chalazion").

One should keep in mind, however, that the meibomian glands are the seat of processes difficult to analyze, e. g., the simple chalazion. Schreiber [16] stated that in trachoma the normal epithelium of the acini may disappear, being replaced by epithelioid cells and giant cells, and that in cases of acute and chronic conjunctivitis the meibomian glands show degeneration and cystic enlargement. One may expect that in considering such growths one will be confronted with all of the difficulties that the dermatologist has to face in relation to sebaceous gland tumors. It is difficult to distinguish between senile hypertrophy, hyperplasia and nevus, especially since the pathologic picture may be confused by the presence of degeneration and inflammation. According to Twort and Bottomley,[20] it is not difficult to induce a proliferation of the sebaceous glands:

> The most effective sebaceous cell stimulant we have met with is oleic acid. This acid causes simultaneously a sebaceous cell hyperplasia of the surface and follicular epithelium. Long continued application may eventually lead to sebaceous adenomas and benign papilloma of the epidermis. We have not meanwhile succeeded in inducing any malignant tumors with the acid used alone, presumably owing to our animals not having been subjected to application of the agent for long enough time.

The concluding sentence of the article is:

> It is suggested that the chief aetiological factor concerned in carcinoma of the breast is a group of components containing the carbon skeleton of phenantrene acting in conjunction with oleic or other unsaturated fatty acids.

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20. Twort, C. C., and Bottomley, A. C.: The Aetiology of Breast Cancer, Lancet **2**:776 (Oct. 8) 1932.

Further, one may encounter in the future the question of sebaceous cell precarcinoma and malignant degeneration of an adenoma, as in tumors of the nipple and mamma.

If there is evidence of malignancy, the diagnosis is relatively easy, but in early cases and cases of so-called adenoma a careful histologic examination is necessary to make the proper diagnosis.

SUMMARY

Tumors of the meibomian glands are either adenomas or carcinomas. The possibility of nevus and carcinoma in situ should be borne in mind. The behavior of the conjunctiva needs further investigation.

The tumor described in its more quiet areas was built up of bands of sebaceous mother cells arranged on a basal membrane, above which there was a successive metamorphosis into sebaceous cells. This is the picture that one might expect to find in adenoma. Usually, however, there was a marked irregularity of arrangement as well as the presence of other types of cells closely related to pavement epithelium (prickle cells, keratohyalin-containing cells and [rarely] horn-producing cells). The sudan III test showed fatty substances, and the polarized light test revealed cholesterol to be present in large amounts. Metastasis developed in the parotid region and in the supraclavicular glands, and the patient died from the effects of the tumor.

The frequency and malignancy of these growths can hardly be estimated, since the diagnosis may be easily missed, a few more than sixty tumors having been described. Since, however, the literature, including the leading German textbooks (Graefe-Saemisch, Schieck and Brückner), gives the impression that tumors of the meibomian glands are generally adenomas, and therefore benign, a serious warning must be given against such a dangerous point of view. Sufficient evidence is present to show that one half of these tumors tend to become malignant.

In cases of tumor of the parotid or supraclavicular region the general surgeon and pathologist should bear in mind that the eyelid may be or may have been the site of the original tumor. When suspicion arises, coloring of a frozen section with sudan III is of considerable aid in the diagnosis.

A METHOD FOR THE STUDY OF THE RETINAL CIRCULATION

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NEW YORK

Although the blood vessels of the retina are available for direct observation in the living animal, their physiologic and pharmacologic responses are not well understood. Many ideas are accepted, based on probability and traditional opinion rather than on adequate evidence. The main difficulties which have stood in the way of obtaining accurate information have been the need for sufficient magnification to discern small changes in the size of the vessels and records to eliminate the necessity for comparison by memory.

Regarding the study of the retinal circulation, Parsons [1] once made the statement that, "The ophthalmoscopic method as applied to animals is open to grave doubt as it is almost impossible to be certain of such minute changes, especially when the optical conditions and the bias of preconceived ideas are taken into consideration." Although recent developments of the ophthalmoscope permit of a high grade of optical accuracy, particularly as applied to the human eye, in all probability this criticism still applies to much recent work. Ophthalmoscopes have been equipped with an optical system by means of which a scale is projected on the fundus and used for measurement.[2] Theoretically this should be of great importance in noting changes in the size of the vessels. While of value in following fairly large lesions, in my experience, the scale has seemed inadequate to determine changes in the caliber of the vessel. Photography of the fundus with the Nordenson camera has made it possible to make records of the human retina over a period of time. Studies by Mylius,[3] Hoessler and Squier [4] and others have been made by this means. The Nordenson camera, however, is not designed for animal experimentation and can be used for this purpose only with difficulty.

From the Research Laboratories, Institute of Ophthalmology, Columbia University.

1. Parsons, J. H.: The Ocular Circulation, London, J. Bale Sons & Danielsson, 1903.

2. Berens, C., and McLaughlin, C. K.: Am. J. Ophth. **17**:402, 1934. Lambert, R. K.: A Simplified Retinal Measuring Grid, Arch. Ophth. **7**:440 (March) 1932.

3. Mylius, K.: Ztschr. f. Augenh. supp. 10, 1928.

4. Hoessler, F. H., and Squier, T. L.: Tr. Am. Ophth. Soc. **29**:254, 1931.

The important contribution of Forbes [5] in developing a method for the study of the circulation of the pial arteries led me to work along similar lines for the microscopy and photomicrography of the living retina.

The principal advantages of the method to be described are: The fundus can be studied under relatively high magnification, and measurements can be made and photographs taken. The apparatus as described is intended for use with animals, so that blood pressure, intra-ocular

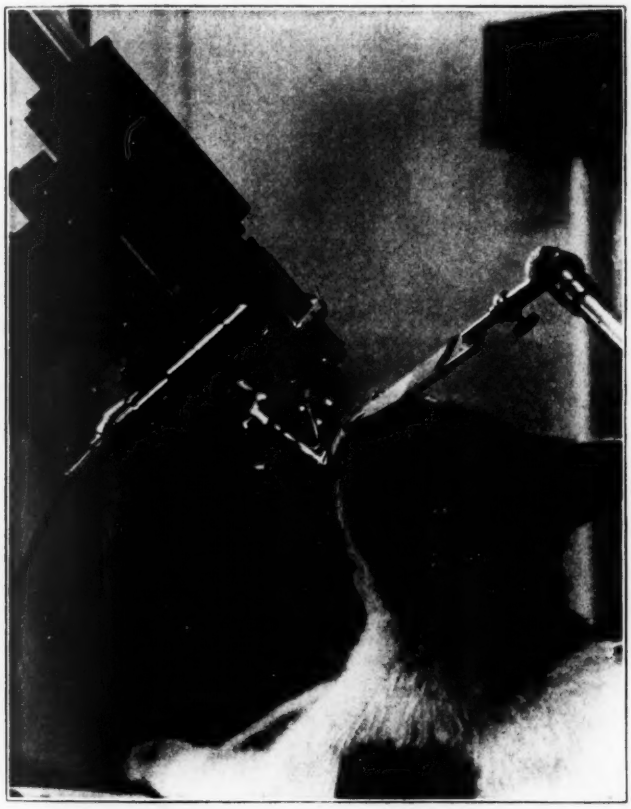

Fig. 1.—A close up view of the apparatus, with contact glass in place.

pressure and other factors may be studied in the same or parallel experiments, and measurable alteration in the caliber of the vessels satisfactorily interpreted.

METHOD

In order to make possible direct microscopy of the fundus, the curvature of the cornea is neutralized by means of a flat-surfaced contact glass. The principle of this type of glass is not new. It was applied by Koeppe to the slit-lamp

5. Forbes, H. S.: The Cerebral Circulation: I. Observation and Measurement of Pial Vessels, Arch. Neurol. & Psychiat. **19**:751 (May) 1928.

examination of the human fundus.[6] In effect, the retina is examined directly through a heavy thickness of a plane-surfaced, homogeneous refracting medium.

In this work a —35 diopter planoconcave lens of from 9 to 12 mm. in diameter, held in place over the eye by means of an adjustable holder, was found to be satisfactory. Liquid petrolatum proved to be the best fluid to use between the contact glass and the cornea, as aqueous solutions of various kinds, for reasons which were not determined, produced corneal opacities. The viscosity of the petrolatum further enables one to hold the contact glass just off the cornea. If the layer of petrolatum runs out from time to time, it will readily flow back from a dropper.

Proper anesthesia and fixation of the globe are of paramount importance, as immobility of the eye is essential for successful photography. I shall describe in detail only the method as applied to cats, as most of the work has been with this animal, although rabbits, dogs and monkeys have also been used.

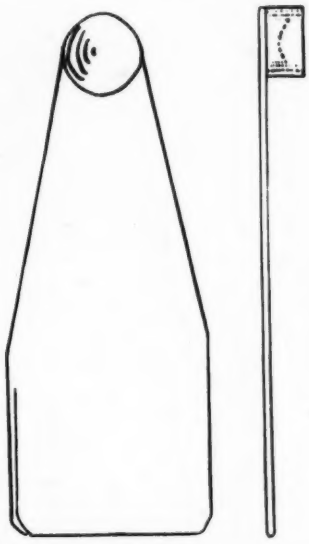

Fig. 2.—A sketch of the contact glass cemented to a glass plate.

Anesthesia was, for the most part, induced with ether; a femoral vein was exposed, and a 10 per cent solution of the sodium salt of secondary butyl-beta-bromallyl barbituric acid was given intravenously.

The cat's head was held in the usual type of jaw clamp, slightly modified so as to give easy access to the eye. The eye was held open by means of a small wire speculum. A fixation forceps was applied to the under surface of the nictitating membrane in order to hold this structure out of the way as well as to provide fixation, care being taken to avoid as much as possible any pressure on or pulling of the globe. Fixation sutures were not found as satisfactory, for there was usually oozing of a small but disastrous quantity of blood under the contact glass.

The Leitz Ultropak microscope, with a self-contained illuminating system consisting of an 8 volt, 0.6 ampere incandescent lamp, was used. With the source

6. Koeppe, L.: Die Mikroskopie des lebender Auges, Berlin, Julius Springer, 1922.

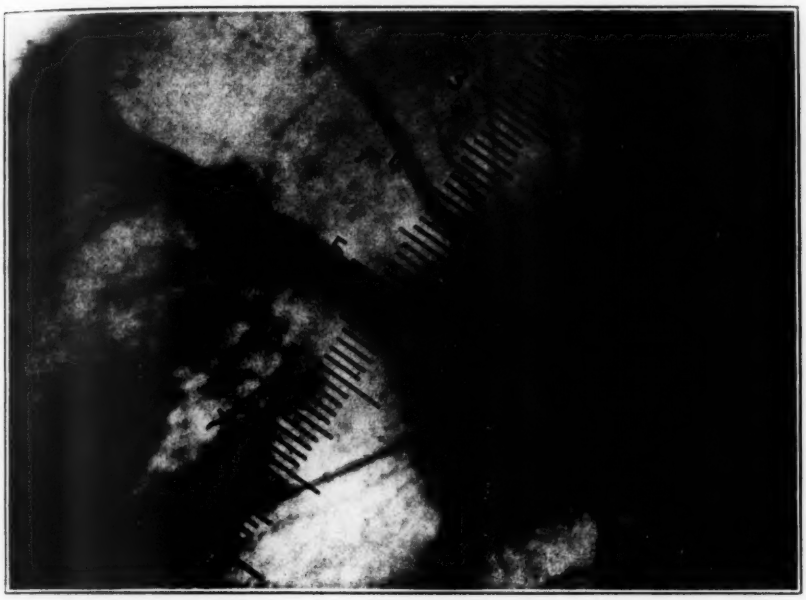

Fig. 3.—Specimen photograph.

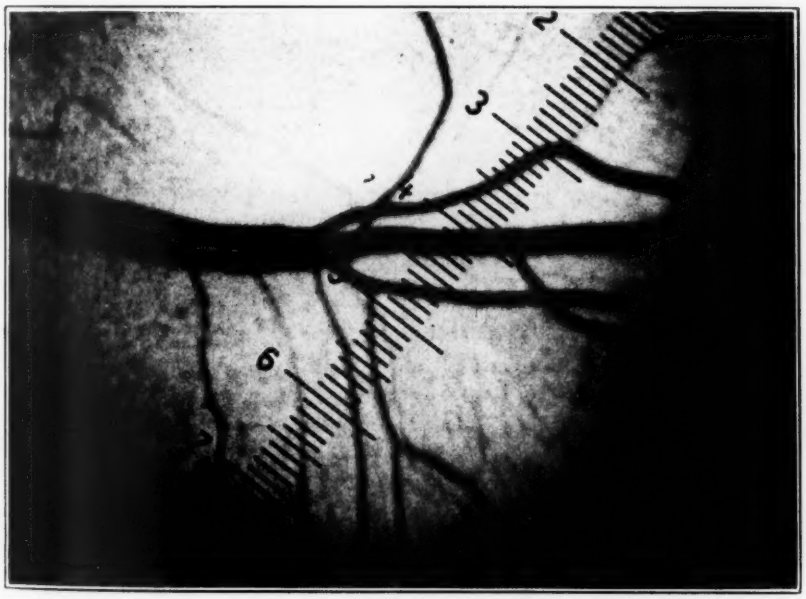

Fig. 4.—Specimen photograph.

of illumination described, a sufficient quantity of heat is generated to produce corneal opacities after a short time, and an Aklo glass filter[7] (medium shade no. 397) used over the bulb provides sufficient cooling. The red-poor color of this filter is also an advantage in obtaining photographic definition.

For the most part a 10 × eye piece fitted with a micrometer and a 3.8 × objective were used, as it was found that higher direct magnifications did not permit a sharp focus because of the depth of the larger vessels and the curvature of the retina. The microscope was held in place over the eye by means of an adjustable stand.

Photographs were obtained with the Leica camera, which permits the taking of a series of exposures without disturbing the apparatus. In most of the experiments done so far, Eastman supersensitive panchromatic film was used with exposures of one-fifth second. It was found that for accurate comparisons it is necessary to keep the exposures and the illumination constant throughout the experiment, as slight differences in the photographic technic sometimes produced misleading appearances of the vessels.

The film should be developed with a fine grain developer. For the most part contact prints were made and studied with a second micrometer microscope. It was thought that this technic was, on the whole, more satisfactory than making enlargements. The micrometers used in the photographing and measuring microscopes were both calibrated against a stage micrometer, so that the size of the vessel at any point could be determined in microns.

ERRORS

The types of error encountered in this method fall into two groups: those incidental to the nature of the experiments and those which it is possible to avoid.

In the first group, there are a number of artificial conditions imposed on the animal, which may modify the interpretation of results. Anesthesia is unavoidable, even though there is reason to believe that the retinal vasomotor reactions are inhibited by it.[8] Dilation of the pupil by means of atropine is also unavoidable, but several control experiments performed on iridectomized cats failed to show any effect from the usual dose of atropine instilled into the conjunctival sac. The relation of illumination to the responses of the retina has been considered by Friedenwald.[9] Some experiments varying the intensity of illumination have been done in the laboratory and will be reported later. The effect of the refracting media over the retina on the apparent size of the vessels was controlled by inserting needles into the vitreous just above the retina and comparing photographs taken this way with ordinary photographs taken under similar conditions. It was found that a constant error of 4 microns was introduced, which was disregarded.

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7. This filter is made by the Corning Glass Works and contains reduced iron.

8. Gruber, C. M., and Roberts, S. T.: J. Pharmacol. & Exper. Therap. **27**: 335, 1926.

9. Friedenwald, J., in discussion on Hoessler and Squier.[4]

Certain errors are easily avoided. As the retina is not a flat field, there is always a certain amount of distortion at the periphery of the photograph. In a series of pictures, therefore, the centering should always be the same, and only the central portion of the photographs used for calculations. The thickness of the vessels makes it impossible to obtain a sharp focus with too high magnification, and with the best definition possible there is always some blurring of the margins of the vessels. This introduces an error which varies depending on the size of the vessel. It was estimated that with a magnification of 40 diameters, an error of ± 7 microns is present in the calculated size of large vessels. Naturally, the exposure must also be rapid enough to minimize the effect of the pulsation of the vessel.

CONCLUSION

A method is herewith described by which it is possible to make relatively accurate physiologic studies of the retinal vessels. Such studies are now being conducted.

This work was made possible by Dr. John M. Wheeler.

A FAMILY OF SQUINTERS

FRANK H. RODIN, M.D.
SAN FRANCISCO

The occurrence of strabismus in the three youngest children of one family is rarely seen. In a previous communication,[1] I reported strabismus in the mother and the three youngest children of one family. There were fourteen children in the family, nine of whom were living. As far as could be ascertained, there was no history of strabismus on either the maternal or the paternal side of the family.

The following report is of three cases of strabismus in a family of seven. The mother and father have straight eyes, and there is no history of strabismus in their families. The four oldest children, two boys and two girls, varying in ages from 13 to 19 years, have straight eyes. The youngest three children have strabismus.

Refraction of the youngest children was done under mydriasis with atropine.

REPORT OF CASES

CASE 1.—The eldest child was a boy, aged 11 years, who had had strabismus since 4 years of age. Vision in the right eye was 20/70 and in the left eye, 20/40. Retinoscopic examination indicated the following correction: right eye, +5.50 sph. ⌒ + 1.50 cyl., axis 120°; left eye, +5.50 sph. ⌒ +0.50 cyl., axis 60°. In a postmydriatic test, the boy accepted the following correction: right eye, +4.00 sph. ⌒ +0.75 cyl., axis 105°, with vision of 20/50; left eye, +4.00 sph. ⌒ + 0.50 cyl., axis 75°, with vision of 20/40. There was an alternating internal strabismus of 15 degrees, as measured by the perimeter arc, the left eye being the fixing eye.

CASE 2.—The second child was a girl, aged 8 years. The left eye had turned in since 3 years of age. Vision in the right eye was 20/40; fingers were recognized at 6 inches (15.2 cm.) with the left eye. Retinoscopic examination indicated the following correction: right eye, +4.00 sph. ⌒ +1.00 cyl., axis 75°; left eye, +4.00 sph. ⌒ +1.00 cyl., axis 60°. In a postmydriatic test the patient accepted the following correction: right eye, +3.50 sph. ⌒ + 0.75 cyl., axis 75°, with vision of 20/30; left eye, +3.50 sph. ⌒ +0.75 cyl., axis 60°, with no improvement in vision. There was a left convergent strabismus of 25 degrees.

CASE 3.—The youngest child was a boy, aged 6 years. The right eye had turned in since 2 years of age. Vision in the right eye was 20/200 and in the left eye, 20/20. Retinoscopic examination indicated the following correction: right eye, +6.50 sph. ⌒ +1.00 cyl., axis 105°; left eye, +6.00 sph. ⌒ +0.50 cyl., axis 75°. In a postmydriatic test, the boy accepted the following correction: right eye, +5.50 sph. ⌒ +0.75 cyl., axis 105°, with no improvement in vision; left eye, +5.50 sph. ⌒ +0.50 cyl., axis 75°. There was a right convergent strabismus of 40 degrees.

From the Division of Ophthalmology, Stanford University Medical School.

1. Rodin, F. H.: A Family of Squinters, J. A. M. A. **86**:1613 (May 22) 1926.

COMMENT

The causes of strabismus are still unknown. As Van Duyse [2] stated:

> For a certain number of hereditary diseases the modus of transmission is not exactly known—for instance, ametropias, strabismus in the etiology of which ametropias have a part. The mode of heredity of these diseases is probably very complicated, because many factors determine them.

Finding strabismus only in the youngest members of two families naturally presents the question whether there is any relation between the age of the parents and the characteristics of the offsprings. There is no clear evidence from experimental data that such a relation exists. In mongolian idiocy the affected person is most frequently the last member of the family.

Three squinters in one family.

Wright [3] studied guinea-pigs in which he found a definite increase in the incidence of certain abnormalities with the advance in age of the mother. He found that the age of the parent (probably of the dam rather than of the sire) is an important factor in cases of polydactylism and the amount of white spotting in guinea-pigs. His conclusion was:

> Whatever the nature of these effects, it seems clear that the age of parent (probably of dam only) has marked effects on color pattern and occurrence of polydactyly among guinea-pigs in which there is a suitable balance of the genetic factors affecting these characters. The results suggest that age of dam may be

2. Van Duyse: Heredity and Eye Diseases, Tr. Ophth. Soc. U. Kingdom **53**:29, 1933.

3. Wright, Sewall: Effects of Age of Parents on Characteristics of the Guinea Pig, Am. Naturalist **60**:552, 1926.

more important as a factor affecting embryonic development of mammals than indicated by the small amount of previous experimental data brought to bear on this question.

Whether this is applicable to man is problematic.

It is possible that this unusual disturbance may be merely a result of chance.

SUMMARY

1. In a previous communication strabismus was reported in the mother and the three youngest children in a family of nine living children.

2. In the present communication, strabismus is reported in the three youngest of a family of seven children. The parents have straight eyes.

3. Whether heredity plays a part in the etiology of strabismus is not well known.

4. The possibility that the age of the parents is a factor should be considered.

490 Post Street.

UNILATERAL OPHTHALMOPLEGIA TOTALIS; PARASELLAR OSTEOCHONDROMA

REPORT OF A CASE

JESSE M. LEVITT, M.D.
BROOKLYN

Rollet [1] grouped tumors in the region of the sella turcica into four classes with respect to ocular signs: (1) the optic or amaurotic form, in which the signs are the result of compression of the visual fibers and which includes the familiar chiasmal syndrome and bitemporal hemianopia; (2) the sensorimotor and cavernous or vascuiar form, in which the signs are the result of pressure on the trunks of the ocular nerves in the wall of the cavernous sinus and on the cavernous sinus itself; (3) the total or opticocavernous form, combining signs of the first two forms, and (4) the exophthalmic form, in which the predominant sign is proptosis. In the second group Rollet distinguishes two types: a pure sensorimotor type characterized by multiple paralyses of the ocular nerves and anesthesia of the trigeminal nerve (the syndrome of Foix), and a sensorimotor and vascular type combining vascular changes, such as chemosis and dilatation of the superficial veins with signs of nerve involvement. He stated that the first type (to which the case here described belongs) is very rare; he has observed only two such cases, in but one of which he had histologic proof of tumor.

Foix [2] described two cases of hypophyseal tumor illustrating the syndrome of the external wall of the cavernous sinus, to which his name has been attached by French authors. He formulated the following dicta: that unilateral ophthalmoplegia of rapidly progressive development accompanied by pain in the region of the ophthalmic nerve should make one think immediately of the syndrome; that lesions of the posterior lobe of the hypophysis, tumors of the temporal lobe and suppuration of the sphenoid sinus may produce the syndrome, and that the

Read before the Brooklyn Ophthalmological Society, Nov. 15, 1934.

1. Rollet, J.: Formes cliniques des complications oculaires des tumeurs de la region sellaire, XIII Concilium Ophthalmologicum Hollandia, 1929, vol. 2, p. 676.

2. Foix, C.: Syndrome de la paroi externe du sinus caverneux (ophthalmoplégie unilatérale à marche rapidement progressive), Bull. et mém. Soc. méd. d. hôp. de Paris **36**:1350, 1920; Syndrome de la paroi externe du sinus cavereux (ophtalmoplégie unilatérale à marche rapidement progressive Algie du territoire de l'ophtalmique) amélioration considérable par le traitement radiothérapeutique, Rev. neurol. **38**:827, 1922.

absence of circulatory disturbance or of roentgenographic evidence should not eliminate the syndrome from consideration.

The following report is concerned with a case of primary basal neoplasm, verified at operation, in which the clinical findings were entirely ocular and were restricted to almost complete unilateral ophthalmoplegia totalis and bilateral corneal hypesthesia. I have not been able to find a similar case recorded in the literature of the past thirty-three years. Additional interest is added by the histologic character of the neoplasm, an osteochondroma with secondary changes, a form of tumor rarely observed within the cranium.

REPORT OF A CASE

History.—Miss M. P., aged 20, presented herself at my office on Jan. 25, 1934, with the complaints of ptosis and blurred vision of the left eye, "crossing" of the eyes, diplopia and headaches in the left frontal region. The first symptom noted was the ptosis in May 1933, following a "head cold" which lasted about two

Fig. 1.—Preoperative photograph showing ptosis of the left eye.

weeks. The headaches were associated with nausea and dizziness. No history of trauma was elicited. The past history and family history were not significant.

Ocular Examination.—Vision in the right eye was 20/20 and in the left eye, 20/50-1; with correction, vision in the left eye was 20/20. To read Jaeger test type no. 1 with the left eye required an addition of a +3 diopter sphere.

Head tilting to the left was noted. There was ptosis of the left eye, the lid covering most of the upper half of the cornea. On raising the lid, a slight exophthalmos became apparent. The eyes appeared straight in the primary position. Excursions of the right globe were full in all directions of gaze; those of the left globe were restricted in all directions to within a few millimeters of the primary position. On an attempt to converge, the left globe remained stationary. The right pupil reacted actively to light; the left was slightly dilated and reacted sluggishly to light, direct and consensual. Diplopia was elicited in every field of vision. Tension of each globe to finger palpation was normal, and there was no sensitiveness of either globe to pressure. Palpation of the left orbit failed to reveal irregularity of the margins or a suggestion of an orbital neoplasm. There was no visible or audible pulsation of the left globe, and no bruit was heard on auscultation through the upper lid or the skull.

With the ophthalmoscope the media appeared entirely clear and the fundi normal in every respect.

The corneal sensation of both eyes was definitely diminished and to about an equal degree in each.

With the Hertel exophthalmometer the right eye registered 16.5 mm.; the left, 18 mm.

Careful studies of the visual field on the perimeter and the tangent screen did not reveal any abnormality.

Slit-lamp examination gave negative results.

The patient was admitted to the Brooklyn Jewish Hospital on February 5 for study.

Medical Survey.—General medical, neurologic and otolaryngologic examinations gave negative results.

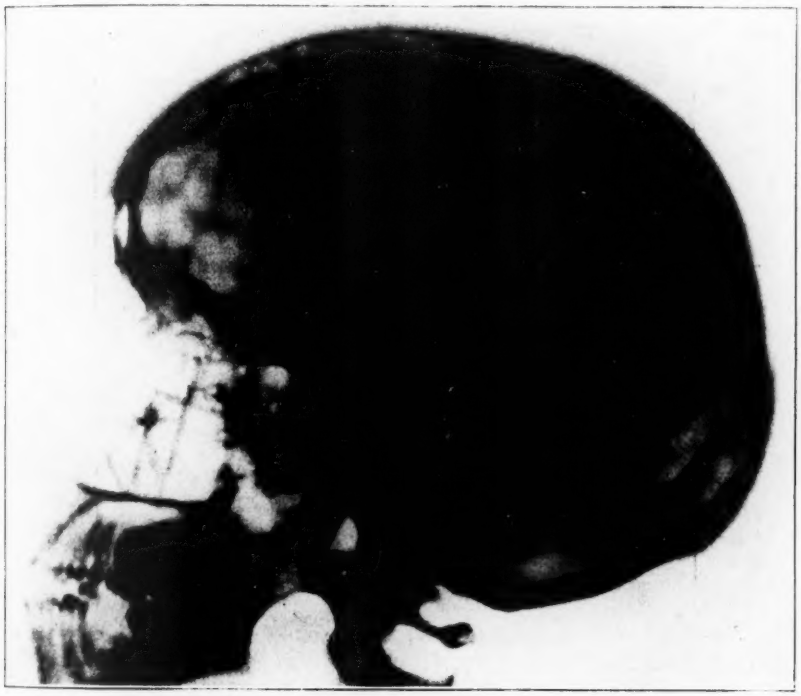

Fig. 2.—Lateral roentgenogram of the skull showing irregular calcification above, behind and within the sella turcica.

Roentgenographic studies of the skull were reported by Dr. M. G. Wasch as follows (figs. 2 and 3): "A lateral study reveals irregular calcific deposit above and behind the sella turcica and extending slightly therein, posteriorly. The character of the deposit is not uncommon with a parasellar tumor containing lime deposit. There is no evidence of increased intracranial pressure. A basal study reveals an area of opacity slightly anterior and mesial to the tip of the left petrous pyramid bone, which corresponds to the calcification observed in the parasellar region in the lateral view."

Examination of the blood showed: hemoglobin, 80 per cent; red blood cells, 4,850,000; white blood cells, 10,000; polymorphonuclear leukocytes, 77 per cent;

lymphocytes, 16 per cent; mononuclears, 2 per cent; eosinophils, 3 per cent, and basophils, 2 per cent. The Wassermann and Kahn reactions of the blood were negative. The blood chemistry was as follows: sugar, 111 mg. per hundred cubic centimeters; creatinine, 1.2 mg.; urea nitrogen, 10.2 mg.; uric acid, 4 mg. Urinalysis gave negative results. Spinal puncture was performed, and 15 cc. of crystal clear fluid was removed; the pressure was 80 mm. of water, rising to 158 mm. on jugular compression and falling to 90 mm. on the release of pressure. Cytologic examination showed: lymphocytes, 1; reaction to the Wassermann and Kahn tests, negative; colloidal gold curve, no reduction; globulin, negative; albumin, 2 mm. ring; sugar, 85 mg. per hundred cubic centimeters.

A preoperative diagnosis of a meningioma or craniopharyngioma lying in relation to the left cavernous sinus was made. Aneurysm of the internal carotid artery was considered but excluded after a study of the films of the skull.

Fig. 3.—Basal roentgenogram of the skull showing an area of opacity (outlined) mesial and anterior to the left petrous pyramid.

Operation.—Operation was performed on February 24, by Drs. Abraham Kaplan and Ira Cohen. Through a left frontoparietal craniotomy the sphenoid ridge was exposed and followed mesially until its junction with the left anterior clinoid process. At this juncture there came shining through the dura a nodular grayish-yellow elevation. The dura over this area was incised, and some reddish-gray material began to extrude itself. This material was scooped out along with two bony hard masses, one the size of a pea and the other slightly larger. As much tumor as possible was removed. Extensive exploration and removal of the tumor did not seem wise because of the critical proximity of the internal carotid artery and the cavernous sinus.

Course.—Convalescence was uneventful. Shortly after operation hypesthesia of the second division of the trigeminal nerve was noted.

Examination of the left eye nine weeks after operation showed the upper lid in a normal position, an absence of the winking reflex, almost complete restoration

of the function of the internal rectus muscle and partial restoration of that of the external rectus muscle, and a moderately dilated pupil which did not react to light, direct or consensual, or widen with the instillation of 4 per cent solution of cocaine, but promptly dilated maximally with a 1 per cent solution of atropine. The visual acuity, fundi and fields of vision were normal.

Roentgenographic study of the skull at this time revealed considerable remaining osseous deposit in the parasellar region.

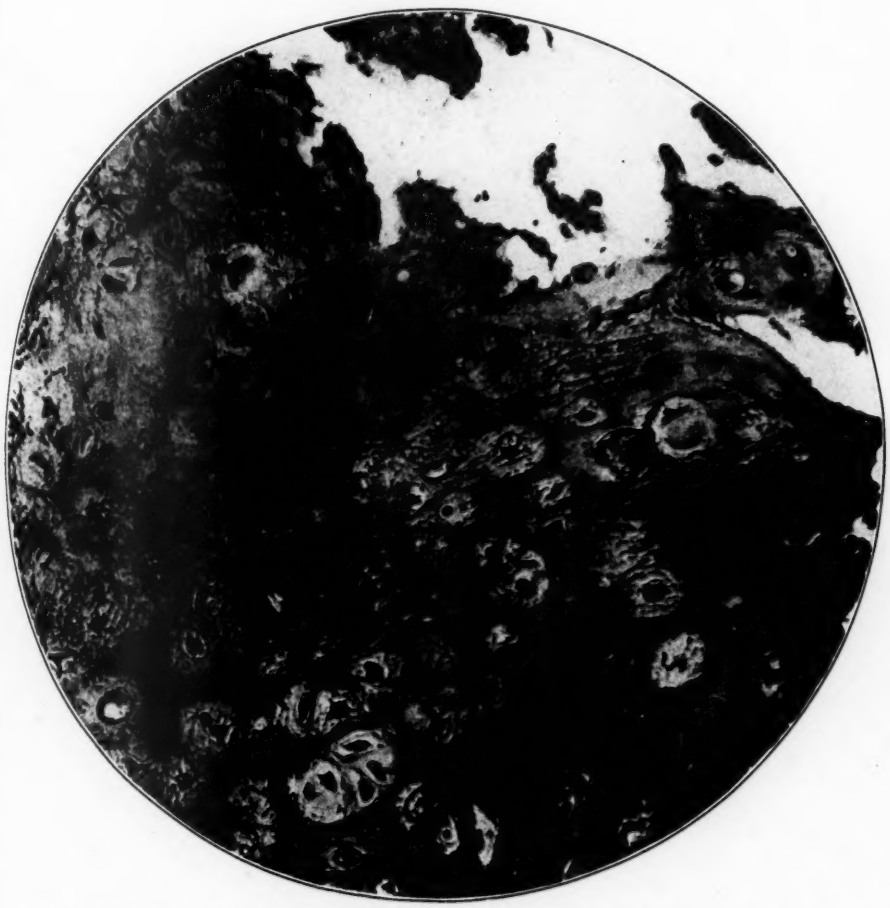

Fig. 4.—High power photomicrograph of a section of a fragment of the tumor showing bone and cartilage tissue.

The patient has received a few courses of roentgen therapy. She has been observed for six months following operation, and there has been no material change in her condition.

Pathologic Examination (figs. 4 and 5): Microscopic sections of fragments of the tumor showed the presence of fairly well developed bone surrounded by periosteal tissue and containing islands of bone marrow. In addition to these, there were islands of embryonal cartilage cells, simulating myxoid tissue. The diagnosis rested between osteochondrosarcoma and osteochondromyxoma.

COMMENT

This report illustrates as a general principle the necessity for a thorough medical survey of cases of paralyses of the ocular muscles in which the etiology is not obvious, particularly since palsies of the ocular muscles may be the initial sign of an intracranial tumor. While uni-

Fig. 5.—High power photomicrograph showing embryonal cartilage cells resembling myxoid tissue.

lateral paralyses of the third, fourth and sixth nerves coupled with involvement of the first division of the fifth nerve pointed to the localization of a lesion within the vicinity of the superior orbital fissure, surgical intervention could hardly have been ventured had not the more concrete evidence afforded by films of the skull established the diagnosis without much doubt.

Behr [3] considered a small rigid pupil which does not react to cocaine or atropine owing to a combined paralysis of the third and sympathetic nerves pathognomonic of a lesion at the cavernous sinus. In my case the pupil on the affected side was slightly dilated and reacted somewhat to light. Vancea [4] and Herzau [5] reported similar observations which disprove Behr's contention.

Babonneix and Sigwald [6] stressed the dissociation between the extrinsic and the intrinsic parts of the third nerve as an aid in differentiating neoplasm from syphilitic disease at the base of the skull. In tumor, the external ocular muscles are likely to become affected first, and the pupil tends to retain some reaction to light until a late stage, owing to the supposedly greater resistance to destruction offered by the oculopupillary fibers of the third nerve. In syphilis the order is reversed.

Laignel-Lavastine and Miget [7] regarded an increased retinal arterial pressure, attributed to a disturbance of the sympathetic fibers along the carotid artery, as a characteristic finding in lesions at the cavernous sinus and especially helpful in distinguishing such a lesion from one located at the superior orbital fissure.

Primary tumors at the base of the skull within the vicinity of the superior orbital fissure may be derived from the meninges, the trunks of the cranial nerves, the bones forming the base, the gasserian ganglion and the blood vessels. Metastatic tumors in this region may develop after the removal of a carcinoma of the breast, or they may follow mediastinal sarcomas. Tumors of a highly malignant character not infrequently spread from the nose, paranasal sinuses and nasopharynx to the cranium to produce involvement of the cranial nerves.

Elsberg [8] has several times encountered meningioma along the cavernous sinus. In a series of one hundred intracranial meningiomas observed at the Neurological Institute and classified as to site, he found

3. Behr, Carl: Zur Diagnose und Symptomatologie der Erkrankungen in der Gegend der Fissura orbitalis superior und des Sinus Cavernosus, Klin. Monatsbl. f. Augenh. **71**:81, 1923; Kurzes Handbuch der Ophthalmologie (Auge und Nervensystem), Berlin, Julius Springer, 1931, vol. 6, p. 230.

4. Vancea, P.: Paralytisches Syndrom bei Erkrankung der Orbitalspitze, Sitzungsb. rouman. Gesellsch. f. Ophth. **27**:6, 1928; abstr., Zentralbl. f. d. ges. Ophth. **22**:530, 1930.

5. Herzau, Werner: Zur Klinik der ein- und doppelseitigen Ophthalmoplegien peripheren Ursprungs, Arch. f. Ophth. **125**:207, 1930-1931.

6. Babonneix, L., and Sigwald, J.: Syndromes paralytiques progressifs des nerfs crâniens par tumeurs basilaires, Gaz. d. hôp. **2**:1505, 1929.

7. Laignel-Lavastine and Miget, A.: Syndrome de la paroi externe du sinus caverneux d'installation rapide au cours d'un épisode méningé aigu, Rev. neurol. **1**:601, 1930.

8. Elsberg, C. A.: The Meningeal Fibroblastomas, Bull. Neurol. Inst. New York **1**:20 and 399, 1931.

two located at the cavernous sinus and twelve at the sphenoid ridge or cribriform plate. Unilateral ophthalmoplegia totalis was present in one of a series of eight cases of parasellar meningiomas arising from the sphenoid ridge, recently reported by Alpers and Groff.[9] A man, 36 years of age, showed in addition homonymous hemianopia and increased intracranial pressure and, on operation, a small fibroblastoma at the most medial portion of the lesser wing of the sphenoid close to the internal carotid artery, compressing the artery, the oculomotor nerves and the optic tract.

Craniopharyngiomas produce characteristic changes of the fundi and visual fields and are apt to be associated with functional disturbances of the pituitary gland. In a clinical study of twenty-one cases, Beckman and Kubie[10] reported six with ocular palsies, most commonly of the sixth nerve. Not a single case showed an involvement of all the ocular motor nerves, nor was there one in which an ocular palsy was present without changes in the visual field or fundi.

The occurrence of osteochondromas and related tumors within the cranium is rare. Guillain,[11] in a thesis on the subject of tumors at the base of the skull, did not mention this type of tumor. In his latest monograph on verified intracranial tumors, Cushing[12] found only three osteochondromas in his series of two thousand and thirty-three cases. He mentioned that these were at the base of the skull projecting into the cranial chamber, producing symptoms by compression, invasion or other complicating factors.

Tumors and inflammation of the gasserian ganglion present typically pain and sensory disturbances in the area of the fifth nerve and a paresis of the muscles of mastication as initial symptoms, followed by implication of the ocular motor nerves with spread of the lesion mesially and of the other cranial nerves with spread posteriorly. Elsberg[13] recorded a case that was clinically somewhat similar to mine. A woman of 28 years showed on examination unilateral ophthalmoplegia totalis with anesthesia of the first and second divisions of the trigeminus nerve and some atrophy of the temporal and masseter muscles and, on opera-

9. Alpers, B. J., and Groff, R. A.: Parasellar Tumors: Meningeal Fibroblastomas Arising from the Sphenoid Ridge, Arch. Neurol. & Psychiat. **31**:713 (April) 1934.

10. Beckman, J. W., and Kubie, L. A.: A Clinical Study of Twenty-One Cases of Tumors of the Hypophyseal Stalk, Brain **52**:127, 1929.

11. Guillain, M. Georges: Le syndrome paralytique unilateral global des nerfs crâniens—contribution à l'étude des tumeurs de la base du crâne, Thèse de Paris 1927.

12. Cushing, Harvey: Intracranial Tumors, Springfield, Ill., Charles C. Thomas, Publisher, 1932, pp. 8 and 133.

13. Elsberg, C. A.: Chondroma Involving the Gasserian Ganglion, Ann. Surg. **84**:88, 1926.

tion, a tumor which proved to be a chondroma, lying in front of the third division of the fifth nerve.

The clinical manifestations of tumors of the nose and throat, and particularly of the nasopharynx, which have spread to the cranium, may be indistinguishable from those caused by tumors arising within the cranial cavity and involving the gasserian ganglion. Findings referable to the point of origin may be entirely absent. Herzau,[5] in illustrating ophthalmoplegia of basal origin, presented eight cases, of which six were cases of tumors derived from the sinuses and nasopharynx. Unilateral ophthalmoplegia totalis was present in two of the nine cases of malignant tumor of the nasopharynx with involvement of the nervous system reported by Hansel.[14]

Many lesions other than neoplasm may produce unilateral ophthalmoplegia totalis. Among these are meningitis of syphilitic, tuberculous or infectious etiology, aneurysm of the internal carotid artery, spontaneous subarachnoid hemorrhage, arteriovenous aneurysm, arteritis or endarteritis of the internal carotid artery, cavernous sinus thrombosis and traumatic lesions. Often accompanying signs and symptoms lead to the correct diagnosis. On the other hand, there are cases in which it may be difficult or even impossible to decide between neoplasm and another type of lesion. Thus Viets [15] reported a case in 1918 which resembled my case quite closely and in which the preoperative diagnosis was tumor at the sphenoid fissure. A woman of 26 complained of right frontal headaches, ptosis of the right eye and numbness and pain over the area of the fifth nerve, and on examination showed ophthalmoplegia totalis, slight enophthalmos and a loss of the corneal reflex of the right eye. At operation an unruptured aneurysm of the internal carotid artery was discovered by Cushing.

Wilson [16] and Collier [17] called attention to the possibility of unilateral cranial polyneuritis affecting all the ocular motor and sensory nerves and thus presenting the picture of total ophthalmoplegia. It is characterized by an onset with orbital pain, slight proptosis, tenderness of the affected globe and paralyses of the ocular nerves which follow in a definite sequence: first the sixth nerve, then the third, the first division of the fifth, the fourth and finally the second division of the fifth nerve. Every patient recovers completely in a period varying from six

14. Hansel, F. K.: Malignant Tumors of the Nasopharynx with Involvement of the Nervous System, Ann. Otol., Rhin. & Laryng. **41**:74, 1932.

15. Viets, Henry: Unilateral Ophthalmoplegia: Report of a Case Due to a Carotid Aneurysm, J. Nerv. & Ment. Dis. **47**:249, 1918.

16. Wilson, S. A. K.: Discussion on Ocular Palsies, Brit. J. Ophth. **5**:349, 1921.

17. Collier, James: Discussion on Ocular Palsies, Proc. Roy. Soc. Med. (Sect. Neurol. & Ophth.) **14**:10, 1920.

weeks to five months. This condition is considered to be of infectious or toxic etiology analogous to a peripheral facial paralysis or Bell's palsy.

SUMMARY

The case reported is one of interest from clinical, roentgenologic, surgical and pathologic standpoints. The patient, a woman of 20 years, complained of left-sided headache and other symptoms referable to loss of motility and paralysis of accommodation of the left eye. Ocular examination revealed moderate ptosis, almost complete ophthalmoplegia totalis and slight exophthalmos of the left eye and a bilateral corneal hypesthesia. General physical and neurologic examinations and laboratory studies yielded negative results. Roentgenograms of the skull served to localize a calcified parasellar neoplasm on the left side. Operation disclosed a tumor at the junction of the left sphenoid ridge and the anterior clinoid process. Microscopic examination showed an osteochondroma with secondary changes. The tumor was probably derived from the sphenoid bone. The ocular findings were the result of compression of the trunks of the third, fourth, first division of the fifth and the sixth cranial nerves coursing in the left cavernous sinus. Two months after operation the upper lid of the left eye returned to a normal position, and the functions of the external and internal recti muscles were partly restored.

This case represents an early type of basal intracranial tumor and illustrates the clinical syndrome of the external wall of the cavernous sinus in a pure form without masking features.

A review of the literature and a differential diagnosis of basal ophthalmoplegias is presented.

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PRACTICAL DETAILS IN THE ORTHOPTIC TREATMENT OF STRABISMUS

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A preliminary report of the possibilities of orthoptic training was presented before the Section on Ophthalmology of the American Medical Association in June 1933. The present report covers the patients included in that report and additional ones who have been accepted for treatment and observed for at least six months. Since the previous report an article by Cantonnet [1] has appeared. Certain classes of strabismus are described which are difficult to remedy. These include strabismus with false macula, the incidence of which among cases of squint he places at 0.5 per cent, and strabismus with paradoxical diplopia, which need not be described here. He believes that patients with strabismus of these types can be reeducated, though with great difficulty.

In contradistinction to many authors, Cantonnet does not believe that fusion training is practical under the age of 5. The upper age limit is much higher than that given by others. He reports good results from training which was begun between the ages of 18 and 35. He is especially enthusiastic about his results in divergent squint, in which some authors have hesitated to attempt training. Taking concomitant squint as a whole, he believes that in 70 per cent of the patients reeducation is possible, although a certain number among these are unaided because of practical reasons such as lack of time and poor cooperation. These conclusions of Cantonnet are borne out by the results obtained at the Northwestern University Orthoptic Clinic during the last eighteen months.

The details of the routine used at this clinic have not previously been given because their efficiency had not been tried thoroughly. The routine for the orthoptic training of nonparalytic strabismus may be summarized as follows:

1. An atropine refraction and determination of the type or class of strabismus

2. A proper correction depending on the type of strabismus

From the Department of Ophthalmology, Northwestern University Medical School, and the Children's Memorial Hospital.

Read before the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, June 14, 1934.

This study was done with the aid of a fellowship supplied by the Knapp Testimonial Fund and a grant from the Academy of Ophthalmology.

1. Cantonnet, A., and others: Le strabisme, Paris, Norbert Maloine, 1932.

3. Improvement of vision of the amblyopic eye (or equalization of vision of the two eyes if possible)
4. Overcoming of suppression
5. Production of binocular perception and superposition
6. Production of fusion
7. Production of stereopsis
8. Training of fusion amplitude
9. Training of duction power

DETERMINATION OF THE TYPE OF STRABISMUS (TABLE 1)

From a detailed observation of over 400 cases of nonparalytic strabismus I believe that a practical etiologic differentiation or classification of cases of squint should be made, and that when such an analysis is possible the prescription of the glass best adapted to the condition can be more accurately determined. Without wishing to draw conclusions too definite as to the etiology of squint in general, I believe that most cases can be classified clinically under one of the following heads:

1. Pseudoparalysis
2. Accomodative strabismus
3. Strabismus due to or associated with fusion defects
4. Strabismus due to or associated with amblyopia
5. Strabismus due to or associated with muscular abnormalities
   (a) Vertical abnormalities
   (b) Horizontal abnormalities
6. Pseudostrabismus
7. Strabismus due to anisometropia and differences in the size of the retinal images
8. Combinations of the aforementioned conditions

To differentiate the etiologic factors and to prescribe the corrective lenses are the next steps. As a diagnostic routine, one observes the motility of the eyes monocularly and binocularly, measures the angle gamma and atropinizes both eyes. The refractive error is corrected, and tests for fusion and phorias are attempted. Then orthoptic training with and without the use of prisms is advised.

Pseudoparalysis.—Three cases of pseudoparalytic squint have been seen. This condition is found in infants and apparently exists from birth. Both eyes converge and appear immobile. No apparent abduction ability can be elicited. It is easy in such cases to make a diagnosis of bilateral abducens paralysis. Atropine instilled into both eyes results in the appearance of the power of abduction and a marked alternating squint.

The refractive errors of the three patients have not been determined as yet because of the extreme youth of the patients. Certainly they do not have paralytic squint. Yet, it is most difficult to differentiate this type from abducens paralysis until atropine is used in both eyes. Atropine alone, therefore, is of maximum aid in this diagnosis.

Accommodative Squint.—Donders, in 1860, emphasized this type of strabismus. He noticed that high hypermetropia was often associated with convergent squint, and myopia with divergent squint. This accommodative type of convergent squint will show much less squint under atropine, and will often disappear when the refractive lenses are worn but will reappear when the glasses are removed. I have seen eyes with 35 degrees of convergent squint become straight under atropine and total correction of the hypermetropia, without any other training. The patients may or may not fuse well, at first, after correction of the

TABLE 1.—*Relative Values of Tests for Determining Common Types of Squint* *

Test	Pseudo-paralysis	Pseudo-strabismus	Accomodative Squint	Squint Due to Fusion Defects	Anisometropic Strabismus	Muscular Squint
Motility	..	..	..	..	..	+
Angle gamma	..	+	..	+	..	..
Atropinization	+	..	+	..	..	..
Refraction	..	..	+	..	+	..
Fusion tests	..	+	..	+	..	..
Phoria tests	..	..	..	..	..	+
Orthoptic training	..	..	..	+	..	..
Prisms	..	..	..	..	..	+

* Amblyopic type omitted.

hypermetropia or myopia and atropinization. Many of them acquire good fusion after a period of five months, without training. Poor amplitude of fusion exists and abduction is underdeveloped unless orthoptic training is carried out. The diagnosis of this type of squint, therefore, is made by measuring the angle of anomaly before and after atropinization. A total correction of the hypermetropia is advised as yielding the best results in this type of squint. After the correcting glass is worn, if the squint disappears, the diagnosis of accommodative squint is confirmed.

Squint Due to Fusion Defects.—Although nearly all patients with squint have difficulty in fusion and may be entirely unable to achieve it when first seen, most of them acquire the ability very rapidly. The theory that there is an absence of the fusion sense in strabismus has been applied particularly to cases of alternating squint. In such cases, with little or no refractive error and normal vision in each eye, it seems likely that the faculty of fusion is inferior to that of normal persons. That it is not entirely absent, however, is shown in the series of seven cases which have been observed at the Northwestern University Orthoptic Clinic. Four of the patients have been able to fuse stereoscopically

and three have been unable to do so. In these three monocular vision of alternating type (pseudobinocularism) has persisted. Of the four in whom fusion developed, there was one in whom the angle of anomaly was 25 degrees whose squint was corrected with the constant use of glasses and with orthoptic training. One patient who had 10 degrees of squint has no squint with or without glasses. Two in whom fusion developed have shown no improvement in the angle of anomaly. The three patients without fusion have remained the same.

Squint Associated with Amblyopia.—In this type of squint, the associated amblyopia may or may not be considered the cause. As with fusion, one is not certain whether the defect in vision is the cause or a result of squint. Taking fields is impossible in small children. Therefore this type of squint is found by determining the visual acuity. The importance of determining this type of squint is emphasized in that by varying the refraction before the fixing eye visual acuity of the amblyopic eye can be improved.

Squint Due to Muscular Abnormalities.—In cases in which methods such as refraction, atropinization and orthoptic training have been tried for some time without effect one is led to believe that the remaining squint is due to a muscular anomaly. This may be verified by taking the motility of the eyes binocularly and monocularly. Such a patient shows good abduction binocularly, but poor ability to maintain a monocular position of abduction after five seconds. This is shown by slow nystagmoid movements of the squinting eye monocularly, or by the appearance of 1 mm. or more of sclera between the external canthus and the limbus of the eye that has defective motility.

A second type of muscular abnormality may appear in cases in which vertical phorias or tropias remain after orthoptic training. After a prism is used to overcome the vertical deviation the visual axes may become parallel. These cases appear especially after surgical treatment has preceded the orthoptic training. A correction of the squint after the use of prisms confirms the diagnosis. These prisms may be used in the glass correction or as slip-overs.

Pseudostrabismus.—Pseudosquint has been called a paradoxical strabismus. Patients at times appear with an apparent divergent squint of 10 degrees. They fuse well and under cover the eyes do not reveal any motion. The measurement of the angle gamma shows this apparent divergence to be due to a wide angle gamma. At times one sees an apparent convergent squint of 10 degrees or less in a patient who possesses good fusion and whose eyes show no motion under cover tests. Measurement of the angle gamma will disclose a narrow or minus angle gamma.

Squint Due to Anisometropia and Differences in the Size of the Retinal Images.—Just what effect the size of the retinal image has on

the production of squint has not been determined. In the new series of charts which I am preparing at Northwestern University the card for measuring the size of the retinal image, as suggested by Dr. Andrews, may be used to measure roughly the difference in size of the retinal images. No doubt patients with anisometropia show differences in the size of the retinal images and are frequently the subjects of strabismus. If one eye is amblyopic, the case falls into the amblyopic group. In cases with good vision, attempts may be made to correct the size difference of the retinal images by the method of Ames and his associates. But as yet little has been done in this direction.

Squint Due to Combinations of Conditions.—It can be seen from the foregoing discussion, and by consulting table 1, that these types of squint exist as isolated types, and also in combination one with another. Especially are the accommodative and muscular types associated.

TABLE 2.—*Methods of Correcting Refractive Errors*

Accommodative Type	Amblyopic Type	Anisometropic Type
Both eyes: Total correction Bifocals (+3.00) for near	Amblyopic eye: Total correction Fixing eye: correction to equal visual acuity under atropinization of amblyopic eye	Correction of size difference by methods of Ames; experimental

CORRECTION OF THE REFRACTIVE ERRORS (TABLE 2)

Following the differentiation of the type of squint, one must decide on the prescription to be given in the case. Table 2 shows that two types may be especially benefited by the glasses prescribed. In the accommodative squint a full correction is to be prescribed before both eyes. At times bifocals with an addition of + 3.00 may be used to suppress accommodation for close objects. In squint associated with amblyopia the total refractive error is prescribed before the amblyopic eye. The visual acuity of the fixing eye is determined under atropine. That lens which produces a visual acuity in the fixing eye under atropine equal to or somewhat less than the acuity of the amblyopic eye is prescribed. In this way binocular vision is stimulated while the amblyopia and suppression of the squinting eye are overcome gradually. After glasses are prescribed and the amblyopia is partially overcome, if possible, fusion training is begun. In spite of consistent attempts to correct amblyopia by atropinization and occlusion of the fixing eye, while varying the color, size and shape of objects before the amblyopic eye, results have been exceedingly disappointing, especially when compared with those of authors such as Sattler, Herzau and Peter. Although in some cases surprising improvement in vision has been recorded, the elimination of errors has not always been possible and in many cases in which accurate observations have been made no improvement has

been noted. While fusion of larger objects has been obtained in many cases with vision as low as 5/200, the amount of vision practical for fusion should be placed at 20/80.

OVERCOMING SUPPRESSION

Suppression is the most important factor to be overcome in squint. There are several ways to overcome suppression:

1. By placing larger objects before the suppressed eye and smaller objects before the fixing eye in the stereoscope
2. By increasing the illumination before the suppressed eye or dimming the light before the fixing eye
3. By moving the charts in the stereoscope
4. By covering the fixing eye for short intervals
5. By the instillation of atropine in the fixing eye
6. By the use of prism slip-overs to produce diplopia and to approximate the retinal images when fusion can be obtained
7. By the use of colored charts

Suppression, when not overcome during the training in the stereoscope, is further overcome by covering the fixing eye several hours daily or by instilling atropine in the fixing eye. Generally speaking, when the vision of the squinting eye is equal to or approximates that of the nondeviating eye suppression may be easily combated.

When suppression is overcome the patient exhibits an alternating fixation of monocular type. This can be verified by watching the patient's eyes through the lenses in the stereoscope, by the pointing test in which he points and describes what he sees, by check charts and by alternating the split charts of Sattler or Guibor. These are four check tests by which the ophthalmologist can determine the progress of the patient and by which he determines the fixing eye, suppression, suspension, monocular vision of alternating type and stereoscopic fusion. In observing the eyes, if the eyes alternate from side to side, monocular perception is present. This may be of two types, i. e., a rapid alternation difficult to detect at times, or a slow alternation easy to see. If the eyes do not alternate and no deviation is present, binocular perception usually is present.

In the pointing test the patient usually uses the hand corresponding to the fixing eye. That is, if the right eye is fixing the right forefinger is used. Secondly, if objects are pointed out exactly as they are on the charts fusion is usually suppressed. If details are described and pointed out as if fused and there is no alternation of the eyes, as determined by the examiner watching the eyes through the lenses of the stereoscope, fusion is present. These details are usually described on the side of the chart corresponding to the fixing eye. If certain charts, such as

the "C" series of the Wells charts, are used for test charts only and not for training, a third method of checking the progress is of practical importance. Some patients will learn most charts during the training periods so that they can describe them accurately. When the check charts, however, which they have not seen, are presented an actual suppression of fusion can be proved and the fixing eye determined. The fourth and very important check measure is the alternation of the split charts. In the Sattler charts the stereoscopic appearance of the fused charts can be reversed by alternating the cards. The double charts are presented to the patient three times. He describes the stereoscopic effect present. Without the patient's knowledge the charts are alternated once or twice. After using several such split charts any suppression of fusion is easily demonstrated by repeated failures to see stereoscopically. After absolute suppression has been overcome, active fusion training is begun either in the stereoscope, amblyoscope or synoptophore. The use of the amblyoscope and synoptophore has been described in the literature elsewhere. In the amblyoscope few stereoscopic pictures are available. Those of Hamblin are extremely difficult and most of the objects are quite small, which makes their use limited.

BINOCULAR MACULAR PERCEPTION AND SUPERPOSITION

The fusion training can be started usually in the stereoscope. The "A" series of Wells charts may be fused by the addition of suitable prisms, the eyes being watched to see that they are not alternated. It is interesting to know at this point that the "E" series of the Wells charts are easier to fuse and to maintain than are the "A" and the "C". This is emphasized in the Guibor series of training charts. The degree of prism is found with which the images may be superimposed. This often amounts to from 40 to 75 prism diopters (base out in convergent squint). It is surprising how rapidly these can be reduced. Often a patient requiring 50 prism diopters at the beginning may fuse without these after one hour of training.

STEREOPSIS

Series "E" of the Wells, the Sattler and the Guibor charts are used next to develop stereopsis. The details of the pictures may be described followed by a period of quizzing. In this way stereopsis is developed quickly. At times all pictures are seen stereoscopically, but with a depth effect which is inverted. This type of stereopsis (pseudo-stereoscopic vision) is not uncommon and is not a hindrance to training. Such patients rapidly acquire depth perception of normal type.

FUSION AMPLITUDE

Fusion amplitude is next developed by moving the stereoscopic pictures toward and away from the lenses. This is produced in the average

case in four orthoptic treatments following fusion. Larger objects are used at first, then gradually smaller ones are chosen to produce a more accurate amplitude of fusion.

DUCTION TRAINING

This is most important and should be attempted only after reading the muscle balance with the Maddox rod for far and near, with and without glasses, and after determining duction power. At this point one must determine the effect of correcting glasses, if worn, on the squint or phoria which remains after fusion training. If, as occasionally happens, a convergent squint or an esophoria is greater with glasses on than off, the pupillary diameter should be made wider to lessen the prismatic effect of strong convex lenses. If the muscle imbalance remaining is unaffected, the pupillary diameter need not be changed. This decentering of the geometric axes of the lenses is most important in divergent hypermetropes. I have seen a divergent squint of 35 prism diopters without the hypermetropic correction become 50 prism diopters with a strong convex lens correction. By narrowing the pupillary diameters of these lenses, the divergent squint was the same with and without glasses.

A second point should be emphasized at this stage of training. A vertical muscle imbalance may persist even after prolonged training. Prism slip-overs overcome the vertical error temporarily until duction power is sufficient to overcome such an imbalance. These prisms should likewise be centered, using the Maddox rod, the B-3 card of Wells or A_{12} of Guibor. During the training of the ductions the strength of these prism slip-overs may be decreased until this vertical deviation remains constant, after which such prisms may be added to the glasses worn.

A third interesting and important fact sometimes noticed at this stage in orthoptic training is a sudden change in the refractive error. If a patient is progressing up to the duction training period and suddenly has a diminution of vision in one eye, an increase in the angle of anomaly and a lessened ability to fuse, it will be found that an atropine refraction will reveal a change in the refractive error. This phenomenon occurs in the younger patients usually, and is probably a normal stage in their development. Though developing duction power may not eliminate a remaining phoria, it aids the patient in combating a tendency to relapse. This duction power is developed by using prisms base in for convergent squint and base out for divergent squint with the stereoscopic charts. These prisms may be used loose or as slip-overs for temporary use during the duction training.

RESULTS

In the report of 1933 a group of patients (series 1) who had refraction, atropinization and occlusion of the fixing eye was compared with

a group (series 2) who had the benefit of fusion training. In addition it was determined that the results in the control group (fig. 1) were as follows: In six months squint was absent in 12.5 per cent if glasses were worn, and in 7.5 per cent if glasses were removed. If occlusion and atropinization were continued one year, squint was absent in 25 per cent if glasses were worn, and in 9 per cent if they were

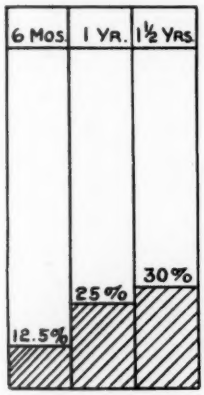


Figure 1

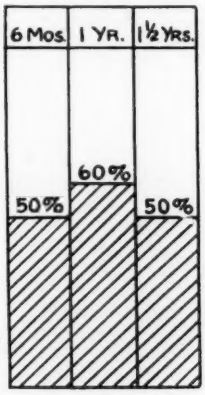


Figure 2

Fig. 1.—Chart showing results obtained in a control group of cases of squint over a period of eighteen months.

Fig. 2.—Chart showing results obtained in a treated group of patients with squint over the same period.

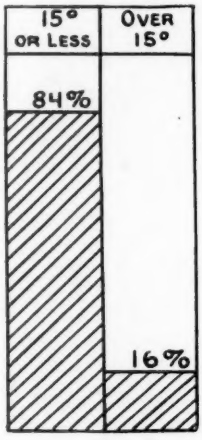


Figure 3

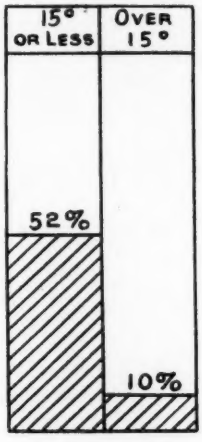
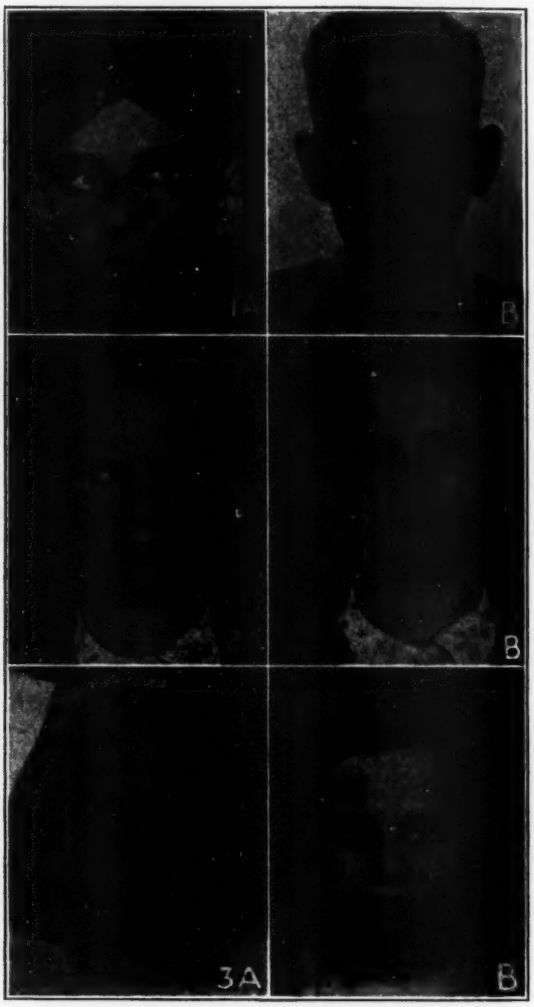


Figure 4

Fig. 3.—Chart showing results obtained in high and low degrees of squint in treated group.

Fig. 4.—Chart showing results obtained in high and low degrees of squint in control group.

Figures 3 and 4, above, have been transposed; the legends, however, are correct.



EXPLANATION OF FIGURE 5

Photographs of three patients are shown to illustrate several of the more severe types of strabismus:

1. J. S., aged 12. A right convergent squint of 25 degrees existing since the patient was 2½ years of age (accommodative type): *A*, before orthoptic training; *B*, after three months of orthoptic training.

2. M. R., aged 16. A right convergent squint of from 25 degrees to 35 degrees (amblyopic accommodative and muscular type): *A*, before training; *B*, after five months of training.

3. L. P., aged 8. A right convergent squint of 25 degrees and a right supravergence of 15 degrees (amblyopic accommodative and muscular type); corrected vision, right, 20/200 and left, 20/20 +3, increased to 20/50 and 20/20 +3 : *A*, before orthoptic training; *B*, after eight months of training.

removed. If these measures were used for one and a half years, squint was absent in 30 per cent of the patients with glasses on and in 20 per cent if glasses were removed.

In the treated series (fig. 2) recovery from squint occurred as follows: After six months of orthoptic training, squint was absent in 50 per cent of the patients with glasses on and in 42.1 per cent with glasses removed. After training one year squint was absent in 60 per cent of the patients with glasses on and in 57.4 per cent if glasses were removed. If such training was attempted over one and a half years, the squint was absent in only 50 per cent with glasses and in 41 per cent without This apparent discrepancy of orthoptic training, that it was able to produce a recovery in not more than 50 per cent of the cases, is due to two factors: (1) most of the new cases admitted were of high degrees of squint and (2) three patients who had an apparent recovery now show some squint at times and so were placed in the improved group. In the control group eight additional patients now have no squint, which produces an increase in the percentage of recoveries in series 1 to 30 per cent with glasses and 20 per cent without.

One must not obtain the idea that patients with a high degree of squint can be relieved as easily as those with a small degree. In figures 3 and 4, cases have been subdivided into those of 15 degrees or less and those of more than 15 degrees. It can be seen that if patients with squint of low degree can be given orthoptic training (fig. 3) over a period of six months 84 per cent will have no squint after such training. In a similar way figure 4 discloses that of the children in the control group with a squint of 15 degrees or less, 52 per cent recover from the squint. On the other hand, only 10 per cent of those with a squint of more than 15 degrees recovered.

Such percentages will vary because of the etiologic factors which have been emphasized in the early part of this discussion.

CONCLUSIONS

1. With the routine described, which has been used at the Northwestern University Orthoptic Clinic, compared with refraction, atropinization or occlusion of the fixing eye, which have been used at the Children's Memorial Hospital, a definite improvement in most cases can be noted, which is emphasized more in the group at Northwestern University.

2. Recovery from squint in series 1 (the untreated group) increases over a period of eighteen months from 12.5 per cent in six months to 25 per cent in twelve and to 30 per cent in eighteen months. This may have occurred because the patients were very young.

3. Recovery from squint in the treated group varies in that the rate of 50 per cent in six months increases to 60.1 per cent in twelve, but is only 50 per cent after eighteen months. This discrepancy is due to a partial relapse in three cases and to the fact that new cases were of a high degree of squint.

4. Orthoptic training produces a maximum recovery from squint in the first six months. After one year an increase in recovery may be noted but this increase is probably very small.

Drs. Gifford and Gamble gave assistance and supervision during the eighteen months of these observations in the clinics at the Children's Memorial Hospital and Northwestern University. Dr. Thomas D. Allen also offered many valuable suggestions.

ABSTRACT OF DISCUSSION

Dr. Lawrence T. Post, St. Louis: The paper presented today is the most illuminating of those thus far produced from this clinic because it presents two features essential to the intelligent treatment of strabismus, namely, a classification of types and an outline of treatment based on this classification. Both seem reasonable, and in general are not radical departures from those which have been used by others, but used by most of them in a haphazard way without the clear definition of the problem that has been made by Dr. Guibor.

In discussion of this broad subject, obviously only a few features can be considered. It would be interesting to know what percentage of the total number of cases is represented in each group of squinters whose squints are of similar etiology. It is my impression that by far the largest number would be that of cases of strabismus associated with amblyopia, and, unfortunately, such patients are very resistant to treatment. It is readily possible to increase appreciably the vision in the amblyopic eye, but seldom is it possible to bring it to normal, if it was quite low originally, and in these patients it is very difficult to overcome suppression.

That there should be, as Dr. Guibor states, a difference of only from 20 to 30 per cent between cases in which orthoptic training was given and those in which it was not given is perhaps a little discouraging. I should like to ask how long a period of no improvement during training would be considered as indicating that the condition was not amenable to further treatment. If practically all that can be done will be accomplished in six months, this at least limits the labor to some such period.

We started an orthoptic clinic at Washington University, under the direction of Dr. William F. Hardy, seven months ago. During the seven months, one hundred and sixty patients have been examined, but many of them over only a very brief period.

Two regular sessions and a supplementary one are held each week, with an average of from eight to ten patients at each clinic. The staff consists of Dr. William F. Hardy, a house officer, a fourth year student and a secretary. Most of the work has been devoted to the tropias.

The largest number of patients in our series was in the convergent strabismus group, thirty-four of whom were watched sufficiently long to draw some conclusions.

Table 3 illustrates the cases and early results. It is merely suggestive, and in no sense final. In most cases training was limited, which accounts for the large difference between the fusion and the stereopsis developed. The table suggests the division of convergent strabismus into different types. The data on many patients were insufficient for the classification suggested by Dr. Guibor; obviously, this was not in mind when the cases were studied.

There were only a few patients in whom operation failed to straighten the eyes when treatment had been ineffectual; so this is practically a complete list of the cases of convergent squint studied sufficiently in the brief life of our clinic to report.

There is one minor point in Dr. Guibor's paper that has not occurred in my experience, namely, a sudden change in refraction in strabismic patients during observation. It is difficult to understand how this could take place anatomically, and if it does not occur anatomically, it would seem to be due to incomplete cycloplegia at one stage or another.

TABLE 3.—*Cases of Convergent Strabismus in Which Eyes Were Straightened*

Type of Squint	Cases	Method of Treatment	Cases	Fusion Developed	Stereopsis Developed
Amblyopic	22 (65%)	Glasses only	3	2	1
		Operation	11	6	4
		Operation and training	6	5	0
		Glasses and training	2	2	1
Accommodative	4 (11%)	Glasses only	3	2	1
		Glasses and training	1	1	0
Alternating	5 (15%)	Operation	1	0	0
		Training	3	1	0
		Operation and training	1	1	1
Due to absence of fusion sense	1 (3%)	Operation	1	0	0
Of unknown etiology	2 (6%)	Operation	1	1	0
		Operation	1	Uncontrollable diplopia	
Total number of cases	34			21(62%)	8(24%)

DR. OSCAR WILKINSON, Washington, D. C.: Orthoptic training in squint is finally receiving the attention its importance demands, thanks to the work done by Dr. Worth, in the first place, and Miss Maddox, of London, Cantonnet, of Paris, and some of our younger men, like Dr. Guibor, in America.

One thing the busy oculist had to learn was that he could not afford to give the necessary time to such patients. Since it was learned that it was necessary to train a lay technician, results have been infinitely better.

The average person is not fitted by temperament or training for this kind of job. Inasmuch as one is dealing with very young children, if one expects to get any results the teaching of these subjects must be pursued not only with an infinite amount of patience and enthusiasm, but with a well founded insight into the psychology of children.

As to the instruments, many are on the market, but I have found none that would compare with the synoptophore devised by Maddox. Just as soon as it can be shown that orthoptic training and glasses will not reduce the degree of squint, and this can certainly be done within two or three months, one should operate. One certainly must measure the deviation of the squint very accurately when the patient first applies for examination, in order to determine what results one is getting. That is important, inasmuch as it will determine within a few

months whether the patient should be operated on. I agree entirely with Dr. Guibor that the less the degree of deviation the more successful are going to be the results. If a case of say 30 to 40 degrees of deviation is present and that amount of deviation has not decreased after the use of atropine and glasses in the orthoptic training within two or three months' time, I feel it is one's duty to set those eyes as nearly parallel as possible, and then one can certainly get better results from orthoptic training.

As to the operative procedure, I wish to issue a warning against the overweakening of the interni in an effort to get parallelism in cases of high degrees of squint, because it will certainly materially interfere with the future use of the eyes.

Dr. Edward C. Ellett, Memphis, Tenn.: In Memphis there has been a clinic for squint in which all the local ophthalmologists have been interested. It has been in operation for six months, and is under the care of a trained technician. In that time enough patients have been given treatment to justify the work and to indicate that it was well received. Some excellent results have been obtained in the improvement of the vision of amblyopic eyes and in training the fusion faculty, but the number is too small to warrant a report of results, nor has the clinic any special observations to offer on instrumentation or methods. It is merely mentioned to show that even away from the larger cities there is a good deal of this work to be done, and when the facilities are supplied, people will be found to use them. The interest and cooperation of the patients and their parents are encouraging.

Dr. George P. Guibor, Chicago: Dr. Post has asked for how long a period of time a squinter should be given orthoptic training with no apparent improvement before surgical intervention is attempted. One extremely interesting phenomenon has been observed in the younger children at the Children's Memorial Hospital: Atropinization and occlusion are carried out over several months' time with no apparent improvement, especially in cases of amblyopic and accommodative squint. Then the patients may come into the clinic with eyes parallel and with slight fusion ability, which has apparently appeared over an extremely short period of time. Three months of observation and orthoptic training should be attempted before surgical procedures are considered, and in younger children six months of orthoptic training may be attempted before surgical correction is considered.

I appreciate the effort involved in the classification of Dr. Post's cases into the groups suggested in this paper. It was no easy task. I shall attempt to classify cases in more detail and will give the results under each group at a later date.

One point that should be emphasized is that the treated patients all had worn lenses correcting their refractive errors for six months previous to any orthoptic training, so this varying factor can be ruled out.

The fact that Dr. Post's patients had not shown stereopsis and yet had shown fusion or superposition of flat objects can be explained by the fact that prolonged attempts for the development and for the diagnosis of stereopsis may not have been attempted. It will take twenty minutes and sometimes an hour to determine whether stereopsis is present or not.

In one case observed by Dr. Post uncontrollable diplopia occurred. I wish to emphasize that all treated patients pass through a definite dissociation stage in which they have diplopia, headaches and vertigo. Gradually these disappear if fusion occurs or if suppression reappears. These facts must be explained to the parents. The sudden change in the refractive error occurs during the duction training stage. I cannot explain this change except that perhaps in refraction

on smaller children the skiascopy probably was not as accurate as it might have been in older patients. The fact that in the partially treated or control groups the smaller children showed 30 per cent recovery, we believe, is due to their flaccidity or to their ability to change their habits more easily than older patients. Dr. Post's suggestion that the clinic establish a routine treatment for the phorias is timely. There is such a routine at Northwestern University, but up to the present this routine has not been mentioned. No clinic for strabismus, I think, can exist without such a routine of orthoptic treatment for phorias, because the end-training in squint is the training of phorias many times.

Dr. Wilkinson's remarks concerning the synoptophore are just; it is an excellent instrument: it is similar to the Worth amblyoscope.

May I emphasize another remark which Dr. Wilkinson made as regards the degree of squint? If a squint is of 5 degrees and is of a severe muscular type, little improvement can be obtained in most cases, the recovery of course depending on the type of muscular disability, whether spastic or paralytic, vertical or horizontal. These muscular types can be classified according to grades 1, 2, 3, 4 and 5. Normally there should be no sclera visible in extreme abduction. For example, in a convergent squint when the patient fixes an object in extreme abduction no sclera will be visible, and no nystagmoid movement should be present. This is grade 1. In grade 2 there will be shown some inability to maintain an extreme position of abduction or there may be exhibited some nystagmoid movements, and so on to grade 5, in which 4 mm. of sclera is visible when lateral movements are attempted; so that in a muscular type of squint the prognosis is poor, and one may operate earlier if this type is diagnosed early in the period of treatment.

On the other hand, there is the accommodative squint which has an excellent prognosis in most cases. One boy had a 35 degree convergent squint and recovered in two months, or as soon as suppression was overcome. Recovery depends on the type of squint rather than on the degree of the angle of the squint in many cases.

PELLAGRA AS A CAUSE OF OPTIC NEURITIS

REPORT OF A CASE

JOSEPH LEVINE, M.D.
NEW YORK

A woman of 47 years, Mrs. C. G., a native American of good social standing in New York City, came to me on Dec. 20, 1933, with the complaint of marked diminution of vision in both eyes which had suddenly occurred while she was reading a week ago. Furthermore, directly in her line of vision was a "large blotch of deep mahogany color." Prior to this there had been no ocular history and her vision for distance had been normal; reading glasses had been used for the past three years. There was no history of trauma. However, for the past seven months there had been persistent diarrhea and during the last two months some vomiting. Her appetite was poor and she had lost some weight, but she still appeared well nourished. She stated that she drank occasional highballs and cocktails but not to excess; cigaret smoking was moderate.

Ocular examination externally was entirely without results except for moderately dilated pupils which, however, reacted promptly to light and on accommodation. The vision was reduced to counting fingers at 1 foot (30.4 cm.) with each eye and could not be improved. Examination of the fundi showed a bilateral exudative optic neuritis with yellowish exudate on the disks extending over the temporal margins into the adjacent retina. The disk margins were entirely obscured, but the swelling was not measurable. The arteries and veins were both full, and in the left fundus a few small round and linear hemorrhages were noted in the retina immediately temporal to the disk. The maculae and peripheries were normal.

The visual fields were slightly contracted for form temporally, and color perception for green was entirely absent in both eyes; there was a large central scotoma for red with the 5 mm. test object extending out nasally to 10 degrees and temporally to 25 degrees. There was a central scotoma for form in both eyes extending to and including the blind spots temporally, and also nasally for 3 degrees.

The history of diarrhea and vomiting together with the optic neuritis led me to believe that some chronic poisoning was the responsible factor, and with this in mind her family physician, Dr. Morris Dinnerstein, performed a Wassermann test of the blood, a complete chemical examination of the blood and a urinalysis and also collected urine to be examined for lead and arsenic. However, on her third visit to Dr. Dinnerstein, December 23, the patient complained of a sore mouth, and examination revealed a stomatitis involving most of the buccal mucosa and some of the pharynx. At this time he went into the history more thoroughly and ascertained that the drinking had not been limited to occasional cocktails and highballs as she had stated originally but consisted rather of a persistent daily imbibing, morning, noon and night with almost complete loss of appetite and abstinence from food for the past year. The sight of meat caused nausea, and she had not tasted meat or eggs for many months; however, her drinks contained fruit juices such as lemon, grapefruit and orange. Her family then confided that Mrs. G. had been very gloomy and despondent for the past six months, secluding

herself and drinking still more whenever she felt more depressed than usual. With this history of insufficient food intake together with the diarrhea, stomatitis and mental symptoms Dr. Dinnerstein diagnosed pellagra following chronic alcoholism. One day later, December 24, there developed the typical dermatitis of pellagra on the dorsa of both hands and both feet extending only to the wrists and ankles. Simultaneously there developed pain and discomfort in both legs, more marked on walking.

The patient was put on a high protein diet and given vitamin B_2 in the form of bemax. Improvement was dramatically rapid, so that the stomatitis was cleared in five days, the diarrhea in one week. The optic neuritis began to subside in three days with gradual improvement in vision. The dermatitis went on to marked scaling, and then healing was rapid, so that no trace was left after four weeks. The optic disks became entirely free from exudate and blurring after four weeks, but paleness of the disk persisted in the left eye. The central scotoma for green and red became smaller and was entirely absent in the right eye on March 15, 1934, but in the left eye a small paracentral scotoma persisted up to May 2. The vision at present, May 19, is: right eye, 15/15; left eye, 15/20, not improved; a small temporal contraction of the left visual field is still present.

It is of interest to note that while the patient was under treatment total abstinence from alcohol was not maintained, and she was allowed a small quantity daily. This had no effect on the improvement of symptoms since the food intake, particularly of vitamin B_2, was sufficient to prevent a relapse.

SYMPTOMATOLOGY

According to most authorities today, pellagra is a nutritional disease with evidences of trophoneurosis and occurs in persons whose diet or digestion is faulty. It is characterized by dermatitis, stomatitis, diarrhea and psychic disturbances, chiefly depression and delirium. "The association of pellagra with alcoholism and systemic disease is explained by the interference with the ingestion or absorption of the pellagra preventive factor because of these morbid states" (J. H. Smith). The stomatitis may evidence itself as only a redness of the buccal mucosa or it may go on to a pronounced stomatitis which at times is confused with Vincent's angina. The dermatitis is always bilateral and symmetrical, and involves the exposed parts such as the dorsa of both hands up to the wrists or of the feet up to the ankles. There are redness and swelling, advancing later to hyperkeratosis and hyperpigmentation. The patients often complain of "dyspepsia and soon the appetite for food vanishes; the sufferers are often those of the more delicate part of the female sex." The outstanding gastro-intestinal symptom is the marked diarrhea, which is persistent and severe. At times there is nausea or vomiting, but this is not common. The severe depression and gloom which the patient suffers form a striking symptom, and the victim prefers to sit alone, brooding, unhappy and disinterested. According to Niles, the presence of any two of the four cardinal symptoms entitles one to make a tentative diagnosis of pellagra, three of these make a strong case, and the four of them make the diagnosis certain.

ETIOLOGY

Minot, Strauss and Cobb reported recently on the importance of dietary deficiency as a factor in the production of alcoholic polyneuritis, and they note that the "toxic" polyneuritis of pregnancy has been considered a dietary deficiency. "The similarity of the symptomatology and pathology of the multiple neuritis of beri-beri due to lack of vitamin B_1 and of alcoholic polyneuritis, leads one to question whether these two conditions do not have a common etiologic basis comparable to the common basis of endemic pellagra and 'alcoholic pellagra.'" The dietary histories of their patients were similar in one respect, viz., lack of appetite, concomitant nausea and vomiting and sometimes gastritis and diarrhea. According to these same authors, the "pathology of one group of alcoholics closely resembles that of beri-beri, where the lesions are essentially a degenerative neuritis of the peripheral nerves. Another group, the Korsakoff syndrome, has a pathology much like pellagra where nerve cell degeneration in the cerebral cortex is the conspicuous lesion." Accordingly, alcoholic pellagra and alcoholic beriberi are acceptable diagnoses today.

Eusterman and O'Leary reported cases of pellagra secondary to lesions of the gastro-intestinal tract, and Wilbur and Eusterman lately saw a case of nutritional night blindness due to lack of vitamin A in a patient with a gastrocolic fistula whose food intake was adequate but in whom absorption was poor because of the fistula; the night blindness disappeared after an operation which closed the fistula. Boggs and Padget classified their cases of pellagra into simple pellagra, pellagra associated with alcoholism, and pellagra complicating another disease.

Not all investigators agree that lack of vitamin B_2 or vitamin G is responsible for the symptoms of pellagra, although Goldberger and Wheeler have given repeated evidence pointing to this causal relationship, and other writers, such as Enright, Culver, Niles, Sure and many more, have practically come to the same conclusion. However, there are many who differ; Spies, for example, reported five cases of pellagra in which the lesions of the skin improved on a diet lower in proteins and vitamins C, D and G than pellagra-producing diets, and many cases have been reported in which improvement did not take place even though the correct diet was given. Thatcher expressed the belief that "from the analysis of the most important research relating to this theory, it is not clear that a deficient diet is the primary cause of pellagra, although there is a dietary relationship." Many will agree with Smith that "the current knowledge of pellagra, if it could be applied, is probably adequate to the prevention of the disease, but is inadequate to its cure in many cases at the time they come under treatment." However, the high incidence of pellagra in undernourished persons, the experimental and epidemiological studies and the success obtained in the therapeutics

and in the prevention of the disease speak very forcibly in favor of the contention of Goldberger and Wheeler that there is a fundamental influence in dietary deficiency. There is ground for the belief that without deficiency pellagra would not develop, and that the disease can be prevented.

In addition to the influence of diet and vitamins, it seems that a deficiency of sulphur in the diet and errors of sulphur metabolism, together with solar radiation, play a part in the causation of pellagra. This can be clarified best by quoting Smith further:

> That there are biologic effects due to radiant energy is not open to question, and that some of these are related to pellagra seems probable. An adequate supply and a normal metabolism of sulphur appear to exert a protective influence against the pathologic effects of solar irradiation. The evidence suggests that an inadequate supply of sulphur as cystine is an important cause of pellagra, and that the abnormal metabolism of sulphur is an important feature of pellagra. The distribution of pellagra and the variations in its prevalence and incidence suggest that solar irradiation, under certain abnormal conditions of nutrition, is an important factor in the etiology of pellagra, and that the reaction to solar rays not only is conditioned by the nutritive state, but depends on a state of the tissues determined by contrasts in degree and intensity of exposure during the animal cycle.

The rôle of solar radiation as a factor in pellagra has been suggested by Enright, Culver and also by American writers. Sulphur in the form of cystine appears to exert a protective action against exposure to solar radiation in low forms of animal life and is present in the epidermis of higher animal life for protection also, perhaps. Cystine, protective against ultraviolet radiation, promotes the growth of vitamin G-containing yeast. The disturbed metabolism on a vitamin-free diet is unable to stand the additional strain put on it by irradiation, as shown in monkeys by Koch and Voegtlin. The rôle of cystine is related to oxidative processes and to the detoxification of cyanogen compounds, both of which functions are disturbed in pellagra. Light and the cystene $\rightleftarrows$ cystine reaction play a rôle in pigment formation (Ropshaw). Cystine is present in the foods recommended by Goldberger to prevent pellagra, and in general these contain cystine or sulphur in proportions comparable to the values assigned by Goldberger for the prevention of pellagra. Lack of cystine may have a specific etiologic relation to pellagra, and an abnormal metabolism of sulphur may be an important feature of the disease; these two factors may be responsible for the development of cataract in vitamin G deficiencies.

PATHOLOGY

Degenerative changes of the nervous system are present, with involvement at times of various columns of the spinal cord, the spinal and sympathetic ganglions, the medulla and the cerebrum. The dura is normal, but small subarachnoid hemorrhages are present, and at times

there is a picture of a true meningomyelitis. There are both edema and atrophy of the brain substance. The nerve cells themselves are degenerated, and the cell bodies contain ingested pigment, so that atrophy and degeneration with pigmentation are seen just the same as in the other organs in cases of pellagra. The glial tissue and the neuroglia are increased, and there are early sclerotic changes in the arteries of the brain, even in young people. In the gastro-intestinal tract there is inflammation of the stomach, small intestines and colon, and often there is ulceration of the tongue, lips and buccal mucosa.

TREATMENT

Among the so-called pellagra preventive foods are listed buttermilk, liver, canned corn beef, canned haddock, canned English peas, dried beans and peas, eggs, green cabbage, canned string beans, fresh beef, milk, canned salmon, wheat germ, tomato juice, dried yeast and canned turnip greens. Besides care with the diet and a good supply of vitamin G, rest in bed is essential; sunlight should be avoided, as it is harmful to the cutaneous lesions. The hygiene of the mouth should be watched carefully, and iron, arsenic and the iodides may be administered by mouth. Intravenous injections of sodium thiosulphate are beneficial according to Smith.

PROGNOSIS

The prognosis is not favorable, as pellagra in any degree, however slight, is a serious disease. Alcoholic beverages are dangerous to pellagrins. Patients over 50 years of age respond less readily. The mortality is higher among females than among males. Mental involvement makes the prognosis worse. A relapse may occur for no apparent reason. "A full year, unbroken by any pellagra symptoms, must elapse before an opinion as to cure may be expressed."

Boggs and Padgett in 1932 reported a mortality of 19.5 per cent in a series of uncomplicated hospitalized cases in which the most favorable treatment was given. Turner in 1931 recorded 31 per cent mortality in New Orleans "in spite of treatment along the most approved lines."

INCIDENCE

Pellagra in this country is extremely common as seen by the following figures taken from the Charity Hospital of New Orleans.

Year	Cases	White Persons	Colored Persons	Deaths	Total Number of Admissions
1925	72	23	49	30	25,953
1926	78	22	56	25	27,252
1927	94	39	55	26	28,962
1928	120	31	89	36	31,363
1929	146	40	106	28	35,833
1930	127	43	84	28	42,636
1931	114	34	80	31	45,531

In Mississippi there were 13,834 cases reported in 1929, and in North Carolina there were 860 deaths from pellagra in 1928.

EYE SYMPTOMS

Such eye symptoms as hemeralopia, diplopia, fleeting scotomas, keratomalacia and cataract are reported fairly often. According to Jaensch, as quoted by Nauck, other ophthalmic conditions are found together with pellagra, such as glaucoma, optic atrophy and central scotomas, but their causal relationship to pellagra is doubted by these authors.

However, among the Italian peasants in whom pellagra was a very common occurrence, Quagliano as far back as 1856 noted pellagrins with hemeralopia. Bietti quoted Lombroso as seeing optic atrophy in 2 cases of pellagra in 1869 and Ottolenghi as seeing mild papillitis in 1 case. Bietti himself saw optic neuritis in many cases of pellagra, and Rampoldi stated that the retina and optic nerve are most commonly affected, then the cornea and next the lens.

In Russia, where pellagra is common among the peasants too, Krylov in 1932 reported 36 cases in the Caucasian Mountains. He found cataract formation even in children, paleness of the nerve heads, sluggish pupils, narrow vessels, scotomas for red and green (in advanced cases), occasional diplopia, hemeralopia and hallucinations. He quoted Kandelaki as having seen 783 cases of pellagra among which Kandelaki observed diplopia, cataracts and hemeralopia. Pathologic examination showed that the "optic nerves and chiasm were somewhat shrunken and the nerve fibres were atrophic with fibroid tissue laid down and some amyloid degeneration with atrophy of the retinal vessels."

Experimental evidence as to involvement of the lens due to lack of vitamin G or of vitamin B_2 has been produced by O'Brien, by Langston, Day and Cosgrove, and others. Shastid in this country observed clinically cases of optic neuritis for which he could find no determining factor, but these cases cleared up quickly when vitamin B was administered.

Lack of other vitamins also affects the eyes, for example, diminution in the intake or utilization of vitamin A causes hemeralopia and xerophthalmia, and possibly some day a definite relationship between retinitis pigmentosa and this vitamin will be shown, although to date these attempts have been unsuccessful. It must be remembered that in some patients lack of a certain vitamin will manifest itself with one set of symptoms only, while in another group other typical symptoms and signs will result; one must not expect all the cardinal signs in every case. Furthermore, there are many people who have only a slight deficiency of certain vitamins and in these only one of the early symptoms may be seen, for example, only hemeralopia of mild degree in cases of mild vitamin A deficiency. Possibly a relationship may be

demonstrated between the utilization of vitamin D and the development of progressive myopia due to thinning of the sclera, and of keratoconus due to thinning of the cornea. In this respect it is of interest to recall that both these conditions often get worse during pregnancy, when there is a great strain on the calcium metabolism and the vitamin D intake. The effect on the eyes of a deficiency of the vitamin intake or of its utilization, even though slight, should be emphasized clinically.

CONCLUSIONS

1. Pellagra occurs frequently in this country.

2. It is more common in the South, where most likely it is directly due to dietary deficiency.

3. In the North it is not uncommon; here it is due usually to dietary deficiency secondary to some other condition such as alcoholism or gastro-intestinal defects interfering with the intake or absorption of food.

4. Ocular examinations should be done in pellagra as a routine to determine the frequency of ocular complications.

5. Partial vitamin deficiency manifests itself clinically in diverse fashion often causing eye symptoms.

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Clinical Notes

A UNIVERSAL PERIMETER

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Only a few hospitals have high grade equipment for perimetry, and the ophthalmologist may find such an examination desperately needed in some hospitals or occasionally in the home. He may use a small portable perimeter, many of which have been constructed. Some are simple and ingenious, but none that I could find provided a full-sized instrument such as is ordinarily used. More than

Fig. 1.—A universal perimeter.

once I have felt the inadequacy of the portable instruments and wished that I might have my office perimeter at hand.

Accordingly, I had constructed a full-sized, illuminated perimeter, with a radius of 33 cm., which will fold up into a suitcase 27 inches (68.6 cm.) in length. The instrument alone weighs 10½ pounds (4.75 Kg.). The arc can be removed quickly from the frame by loosening a hand bolt. The chin-rest screws onto the frame. Three thumb screws hold the frame rigid. Set up, it is as substantial as any instrument I have seen and can easily be carried in one hand. With an ordinary leather strap, it can be quickly suspended above a bedridden patient. In figure 3 the head of the bed extends only 15 inches (43.2 cm.) above the mattress, yet the perimeter is firmly suspended above it.

The arc is 5 inches (12.7 cm.) wide, giving a broad background. It is constructed of stainless steel 1/32 inch (0.08 cm.) thick. A rib of cold rolled steel, 1/16 by 9/16 inch (0.64 by 1.44 cm.) holds it rigid. Fixation is obtained by sighting through a hole in the bolt which supports the arm of the perimeter. The arc is painted black, but could be covered with gray if desired.

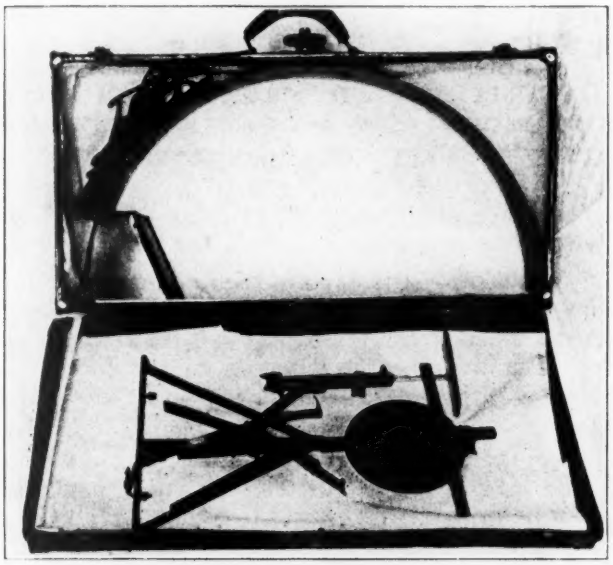

Fig. 2.—The perimeter folded up in its case.

Fig. 3.—The perimeter set up for use.

The illumination is furnished by a round 50 watt daylight bulb enclosed in a tin box on one arm of the arc. A frosted glass opening diffuses the light along the arc, giving 7 foot-candles at the end of the arc and 10 foot-candles at the center.

The frame is made of 1/16 by 9/16 cold rolled steel. It is light and rigid and not easily upset.

I feel that this instrument meets most of the requirements of perimetry except where the tangent screen is needed, and it cannot be expected to replace the screen. Its portability makes it highly useful under all conditions where perimetry can be done.

Gibson & Doty, Opticians, 652 Main Street, Buffalo, provided technical aid in building the instrument.

THE COMPOSITION AND MAGNETIC QUALITIES OF THE VARIOUS FORMS OF STEEL COMMONLY USED IN INDUSTRY

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For years ophthalmologists have recognized and emphasized the fact that different kinds of steel have varying properties, which is of prime interest when intra-ocular foreign bodies of steel are encountered. The type of steel, in addition to the situation of the foreign body in the globe, undoubtedly plays a part in the development of siderosis.

Furthermore, many oculists believe that the composition of the steel foreign body in the eye determines the ease with which it can be removed by the magnet. To illustrate the latter point, the chemical composition of the different forms of steel commonly used is shown in the following tabulation obtained from the United States Steel Corporation and its subsidiaries:

Specimen A: Low carbon steel plate, used for car plates (from 0.15 to 0.25 per cent carbon plain steel).

Specimen B: High manganese steel, used for street railway track work (from 0.95 to 1.40 per cent carbon and from 10 to 14 per cent manganese).

Specimen C: Intermediate manganese steel, used for car axles (from 0.3 to 0.4 per cent carbon and from 1.6 to 2 per cent manganese).

Specimen D: Chrome-nickel steel, used for street railway track work (from 0.45 to 0.55 per cent carbon, from 0.85 to 1 per cent chromium and from 2.75 to 3.25 per cent nickel).

Specimen E: Chrome-nickel-molybdenum steel, an abrasion-resistant alloy steel (from 0.7 to 0.8 per cent carbon, from 1.4 to 1.6 per cent chromium, from 0.5 to 0.75 per cent nickel and from 0.3 to 0.4 per cent molybdenum).

Specimen F.: Chrome-molybdenum steel, used in commercial steel castings (from 0.3 to 0.4 per cent carbon, from 0.75 to 1 per cent chromium and from 0.3 to 0.4 per cent molybdenum).

Specimen G: Copper-bearing steel, used for car plates (from 0.15 to 0.25 per cent carbon steel, with a minimum of 0.2 per cent copper added for corrosion resistance).

Specimen H: Gray cast iron, used for commercial iron castings (from 3 to 3.5 per cent total carbon, from 2 to 2.5 per cent silicon and from 0.5 to 0.7 per cent manganese).

Specimen I: Lorainite, an alloy cast iron for abrasion resistance (carrying approximately 2 per cent chromium and 4 per cent nickel).

Specimen J.: Chisel and hammer steel (from 0.85 to 1 per cent carbon steel).

Specimen K: Rail steel (from 0.6 to 0.75 per cent carbon).

Specimen L: Chrome-manganese steel, a high manganese steel such as specimen B, carrying in addition 1 per cent of chromium for added abrasion resistance.

It is readily seen that only two of these specimens contain a fair percentage of any metal other than iron, i. e., specimens B and L, which have from 10 to 14 per cent of manganese.

The specimens delivered to me measured roughly ⅛ by ½ by 1 inch (0.3 by 1.2 by 2.5 cm.), and each of these was tested with the electromagnet. Furthermore, small, fine particles of each specimen were ground, and these were also tested with the electromagnet. It was found that all the specimens except B and L were quickly and strongly attracted by the magnet at identical distances, which could be increased up to 2½ feet (76.2 cm.). Both B and L had to be brought up to within ½ inch of the tip of the magnet, and even then were only slightly attracted; they could then easily be removed from the magnet, for which they had slight affinity, while all the other specimens could be removed only with difficulty and with the expenditure of some energy.

Specimens B and L are used for street railway track work, and I believe that intra-ocular foreign bodies from this source are extremely rare. However, most of the foreign bodies come from hammers and chisels, and specimen J, which represents this type of steel, is highly magnetic. Accordingly, the great majority of intra-ocular iron foreign bodies with which oculists may be concerned have magnetic properties sufficiently great to permit of their removal by a giant magnet. Furthermore, chisel and hammer steel and also rail steel (specimen K) have the purest iron composition, and these two should produce siderosis most quickly if given a favorable intra-ocular position, such as the uveal tissue or the vitreous body.

Ophthalmologic Review

HUMAN RODS AND CONES

THE STATE OF KNOWLEDGE

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IOWA CITY

The present seems a favorable time to take stock of the knowledge, theories and impressions of the visual cells and their mode of operation. Advance in the histology of the human retina practically ceased with the publication of Greeff's classic monograph in 1900, but photochemical and photophysical theorization as to the nature of the visual process continue. So many ideas in circulation at present have their basis in real or supposed cytologic features of the visual cells that there is need for a reexamination of these features and for indications as to what still needs badly to be done, histologically, to enable one to eliminate some of these conflicting ideas and prepare one to consider the next crop.

It is hoped, then, that the reader who is familiar with the principal reference books and interested in current theory will find here some aid in developing a defense against the plausible. He should not be surprised at finding that this brief review emphasizes ignorance rather than knowledge. A great number of facts have been learned concerning visual cells in general, but there are actually not many which can be positively asserted for man.

SIZE AND FORM

In approaching the subject, it is logical to consider first the size and shape of the elements. These matters are in a satisfactory state so far as the rod [1] is concerned, for this cell is preserved well by most fixatives and has a standard appearance in all. In the case of the cone, however, the delicacy of the outer segment is such that one finds great variation in the dimensions given by various authors. Ideally, the measurements should be made on fresh, unfixed material; but postmortem changes are so rapid that this is practically impossible, and the

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1. The terms "rod" and "cone" as used here are applied to the visual cells in their entirety, not merely to the portion which projects through the limitans—an artificial restriction of the terms still made by some.

validity of measurements made in sections will depend on the quality of the fixation. The inner segment is quite durable, and its appearance is fairly uniform, but the outer segment of the human cone, it is safe to say, has yet to be preserved in anything like its living condition.

The classic drawings of Greeff (fig. 36) of cones from various zones of the retina have been copied innumerable times by other authors. They show the outer segment to be short and conical, excepting in the cones of the macula. The trustworthiness of these figures has never been questioned, in spite of the fact that they were drawn from material fixed in osmic acid and macerated, not sectioned—the same material from which Greeff drew his figure 32, showing various modes by which the outer segment disintegrates post mortem!

There is thus good reason to doubt the normality of the outer segments in Greeff's drawings. I have called attention (Walls and Culler) to the length and subcylindricity of extrafoveal cones when given careful technical treatment,[2] and have indicated my opinion that human cones would appear like those in Garten's photograph of the retina of Macacus rhesus (fig. 1) if only human material could be preserved intracardially as was Garten's. The true size and form of outer segments of extrafoveal cones must then be considered unknown, and it seems idle to quote dimensions given by other authors. The reader will find reliable, closely agreeing figures for the rods and for the inner segments of the cones of various regions in any standard work on ophthalmology. The diameters of inner segments are the most important dimensions of visual cells, for they set the limits of retinal visual acuity.

Human cones from different retinal zones differ markedly, but the variation in form is smooth, and distinct types never occur side by side as in the retinas of most submammalian vertebrates. Going from ora to fovea, the changes in the form of the cone are: a slenderization and slight lengthening of the inner segment, which accelerate in the macula, and a lengthening (very marked, according to Greeff) of the outer segment. The form of the cone thus passes from a long-necked bottle at the ora to a dowel at the center of the fovea. The outer segments are certainly longer in the fovea than elsewhere, but my sections indicate as nearly a uniform length for extramacular cones as for the rods. The increase in length in the fovea compensates for the decrease in diameter there and maintains the volume of the outer segment (and hence the threshold) at a value comparable to that of the extrafoveal

2. This technic consists of: evisceration of the fresh globe without distortion, fixation in Kolmer's (1909) fluid, slow dehydration and embedding in pyroxylin (celloidin).

cones. The elongation is scarcely an indication of the assumption of rod functions by the foveal cones, as Parsons (1924) believes.

NUMBERS, ABSOLUTE AND RELATIVE

The numbers of rods and cones in a human eye might seem to have only academic interest, but when it is realized that the ratio of visual cells to optic nerve fibers is far from 1 : 1, it is seen that the numbers of cells and fibers are important factors in sensitivity and visual acuity, apart from the effect of the concentration of visual cells per unit area of projected visual field, for the more visual cells per opticus fiber, the higher the retinal sensitivity and the lower the retinal visual acuity.

Other estimates have been made, but those of Krause—800,000 opticus fibers,[3] 7,000,000 cones and 130,000,000 rods—were the most painstakingly computed. Ramón y Cajal's work revealed that most of the summation is in the rod bipolars, the peripheral cones being synapsed in smaller numbers to bipolars and the foveal cones having each a neuron to itself. Probably a majority of the afferent opticus fibers carry impulses from cones, but the relative numbers of opticus fibers of the rods and cones can only be guessed. The brute character of scotopic vision, apart from the effect of dilatation of the pupil, is entirely due to the large area of the visual field subtended by a single scotopic cortical element, in contrast to the more nearly point-for-point correspondence of the objective and subjective visual fields when the pure-cone, "fine-grained" fovea is in operation in intensities above the cone threshold.

With regard to the number of cones in the fovea and the number per unit area in that all-important area, there are again contradictory reports because of differences in fixation. The anatomic preservatives which prevent foveal rupture make it impossible, unfortunately, to distinguish a macular cone from a rod, and the shrinkage of the retina in all histologic preservatives stretches and ruptures this region, which is thin and therefore weak. The resultant distortion renders precise mensuration impossible.[4] There is no general agreement as to the diameter of the rod-free area, and estimates—between which no choice is possible at present—ranging from 4,000 (Krause) to 13,000 cones (Becker) in this area are mentioned by Greeff. Here again, as with the form and size of the outer segment of the cone, one has to do with values which are of the utmost importance to the physiologist and the psychologist interested in vision; but the ophthalmologist can be of

3. Many are efferent.

4. It also probably accounts for the Fritsch-Heine controversy (Arey, 1932) over the question of the circular or hexagonal cross-section of foveal cones (but see Heine).

no real help to them, and they are free—and prone—to use for their computations the estimates which best suit their theses.[5] Reliable figures will doubtless be obtained eventually, but not until the problem of fixation without distortion has been solved.

RELATIONSHIP TO CONTIGUOUS STRUCTURES

The multiple connections of rods to rod bipolars and the comparative isolation of cone conduction have already been touched on.

The mode of attachment of the visual cells to the external limiting membrane is of an unknown nature. In many of the lower animals "basket fibrils"—threadlike projections from the limitans—form a calyx at the base of the inner segment and are probably fused lightly with

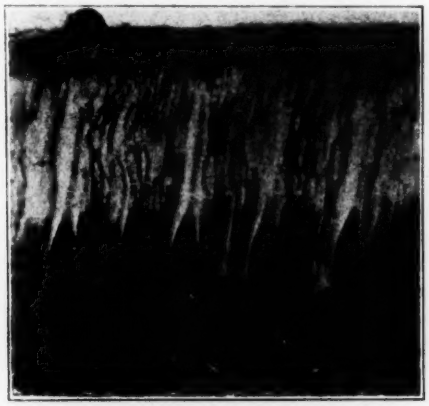

Fig. 1.—Visual cells of Macacus rhesus, after Gårten. Note the size and form of the outer segments of the cone.

its sheath. Such fibers have not been seen in human material, though they are often drawn in semidiagrams. The nuclei of the visual cells are, of course, firmly bonded by the spongelike distal ends of Müller's fibers, and thus incidentally to the limitans, which is formed by the expansions of the latter.

Greeff's figure 30 shows the inner segment of the rod tapering to a point at the limitans. This is wholly false, for while the rod fiber does become filamentous, it is at some distance below the limitans. Greeff's

5. As in the case of Hecht's use of the figure—of unstated source—of 13,500 foveal cones per square millimeter, which makes his value of 540 foveal cones per unit visual-acuity-area check perfectly with his data on the number of least noticeably different steps in discrimination of intensity. The figurer, rather than the figures, seems to stand behind this important part of the evidence for Hecht's theory of the relation of visual acuity and illumination.

material, being teased, would not have shown the level of the membrane clearly. In sections, the rod is seen to flare slightly rather than to constrict, where it passes through (fig. 2). This flaring, characteristic of the cones as well, makes for a firm foundation, but, as noted previously, it is not known whether there is actual continuity of the material of the limitans with that of the sheath of the inner segment.

The relation of the outer segments to the pigment epithelium, so far as man is concerned, has usually been considered a simple abutment and is so diagramed, except by those who assume an extensive migration of the retinal pigment.[6] Halben, however, argued at length (with justification) for a firm frictional bond between the sides of the visual cells and the interdigitating processes from the pigment epithelium. Pigment cell processes, even pigment-free ones, long enough

Fig. 2.—Rod from the extramacular fundus of a normal human retina, from a preparation of H. D. Judd, obtained by operation. Kolmer's fluid; × 1,000. *O* indicates the outer segment; *E*, the ellipsoid; *L*, the external limiting membrane; *N*, the nucleus.

actually to reach between the tips of the outer segments—to say nothing of passing down their whole length—have never been photographed or

6. Arey (1915) pointed out years ago that while many texts on physiology and histology describe rapid and extensive photomechanical changes for human beings, the description is based on fishes and amphibians. Since Arey's note no attempt has been made to demonstrate migrations in man. Van Genderen Stort gives the measurements of the cones of one human eye which had been dark-adapted fourteen hours, but there are no records of definitely light-adapted eyes to place with this, and many experiments would be needed if the averages obtained are to be significant and capable of answering the question. Yamanaka's interpretation of an unusual position of the retinal pigment granules in Oguchi's disease as due to migration and hence "atavistic" is most dubious.

drawn, though they are often enough assumed to exist and are included in diagrams (e. g., fig. 43 of Eisler).

Figure 3 shows a situation which I believe to be as yet unreported but which appears to be normal for the extramacular retina if not for the macula as well. This intimate relationship of the cones alone to massive (but delicate) pigment cell processes was first seen in preparations made by H. D. Judd of Detroit and stained with Kolmer's fluid, and later in sections made subsequently by me. The absence of such processes associated with the rods, or of any other true processes from the human pigment epithelium, renders the tubular ones so conspicuous that in low power magnification the cones may be counted by looking only at the pigment epithelium.

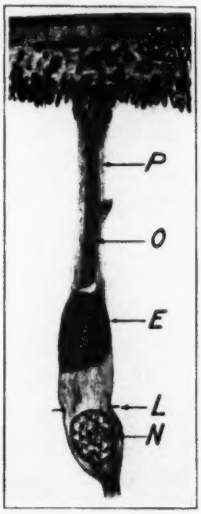

Fig. 3.—Cone from the extramacular fundus of a normal human retina, from a preparation of H. D. Judd, obtained by operation. Kolmer's fluid; × 1,000. *P* indicates the tubular process of the pigment cell; *O*, the outer segment; *E*, the ellipsoid; *L*, the external limiting membrane; *N*, the nucleus.

The tubular process ensheathes the outer segment practically as far as its junction with the inner segment. The protoplasm of the process is of low density; at least it stains a delicate, light blue in Mallory's triple stain in contrast to the deeper blue of the inner segment of the cone and the bright orange of the outer segment. The boundary of the outer segment is easily seen, at least proximally, because of the color contrast. Distally, however, either the outer segment is fragmented artificially, or else its substance becomes continuous with that of the pigment cell—a relationship described for the immature visual cells of the salmon by Fürst. The superbly fixed cones of Macacus rhesus in

Garten's figures show neither the distal dissolution of the outer segments nor the tubular processes. Whether the latter are unique in man and lacking in the macaque, or are present in primates in general but somehow destroyed by Garten's procedures, remains to be seen.

Whatever the exact relationship of these processes to the outer segment of the cone may be, they probably have a purely trophic function. It does not seem probable that they have an optical value in isolating the outer segment, for there are never more than a few of the tiniest of pigment granules in them. The entire complex fits neatly into the popular notion that the cone is more highly metabolic than the rod.

CYTOLOGY AND CYTOGENY

Discussions of the minute structure of visual cells usually permit the reader to assume that all the features described have been found in the rods and cones of man. Many organelles, such as oil droplets and paraboloids are definitely lacking in man, but it can be said that given the same quality of fixation possible with smaller eyes, the human visual cells will probably reveal the same systems of fibrillae and the same cleancut outlines of the component parts as are seen in the lower animals.

For the success or failure of some current ideas of visual physiology, the most important, and unfortunately the most controversial, cytologic matter is the structure of the outer segment. The evidence for this being the percipient organelle of the cell is very considerable, as will be seen later. Consequently, a physical basis in the structure of this part will always be sought by the proponents of successively newer theories of vision and adherents of the older ones.

The pertinent facts which are quite beyond argument are: The outer segment is doubly refractive, and its ground substance is lipoid; it has a thin sheath, which in the case of the rod is open at the tip; it contains a material called "myeloidin" by Kühne. The question in most urgent need of solution is whether or not a portion of the outer segment content is organized into a pile of disks, set transversely in the outer segment with a small amount of another material, of different refractive index, around and between them.

This appearance is often afforded by slender outer segments stained with hematoxylin; but an alternative explanation, first offered by W. Krause, that the "disks" are but turns of a tightly wound spiral filament (or filaments) has as much or more evidence behind it.

It is the possible optical behavior of the hypothetic disks (provided they exist, and also exist optically)—their action as a mirror, as an echelon, or as a tuned and resonant system—which accounts for the

great interest in this otherwise minor and academic point. The possible significance of the presumptive spiral threads is of scarcely less interest, though to a different group of investigators—those concerned with the problem of the nature and ancestry or former condition of the visual cells of vertebrates, for though the spiral filaments have often been considered neurofibrillae, they are open to another interpretation in connection with a theory that the visual cells are not neurons and not neuro-epithelium, but rather sensory ependymal cells. The two schools of thought are equally vociferous, and the reader should consult prominent converts of both (e. g., Arey, 1932; Franz, 1934) before drawing even tentative conclusions. Certainly physiologic speculation is idle as long as the cytologic question remains open. It seems, however, that if the difficulty lies in the fact that both spiral and discoid organizations can and do occur in different animals, then neither arrangement can be essential for vision.

I have long been convinced of the presence of spirals in the relatively plump outer segments of the retinas of many of the lower animals, where they are exceptionally clear when not too heavily stained. Insufficient destaining, however, resulting in the loops of the spirals nearest the objective alone being visible, leaves the latter coarser and apparently discontinuous, and can easily lead one to favor the hypothesis of the disks.

Another filament system, of dubious physiologic importance, but of great interest from the standpoint of the history of the visual cells, is the centrosomic system, consisting of a diplosome in the outer end of the inner segment from which a short filament runs vitread (the Kolmer-Held fiber) and a much longer one (Fürst's fiber) sclerad, in the periphery of the outer segment (rarely axial) to the tip of the latter.

These elements are described in most discussions of the adult human retina as though they had been seen there, and have been added by Arey (1932) to his copies of Greeff's drawings; but though found in apes by Uyama and Menner (1931), these structures have yet to be identified in adult human material. The Fürst fiber and the diplosome were seen in the fetus by Seefelder, however, the fiber, which is naked at first, being the first part of the visual cell to differentiate. Becoming soon encrusted with mitochondria, it forms the anlage of the outer segment (Leboucq, Magitot, Mawas and Seefelder).

Though it was worked out a quarter of a century ago, it has never been pointed out that this flagellum-like structure of the young outer segment—a centrosomic filament ensheathed in mitochrondia, which perhaps even have a spiral disposition as in a sperm tail—affords the best of evidence for Studnička's theory that the visual cells of vertebrates were

once ependymal cells, which he based largely on the position of the inner layer of the optic cup as a continuation of the ependymal layer of the wall of the brain.[7]

The inner segments of human visual cells have a relatively simple structure, for while as many as four distinct organelles are differentiated in the inner segments of the cones of some of the lower vertebrates, the human rod and cone each contain but one formed element, the *Fadenapparat* or ellipsoid (figs. 2 and 3). In submammalian retinas this is a solid body, but its human homolog is a barrel-shaped mass of longitudinal fibers which are more conspicuous and proportionately longer in the cone. The chemical nature of the ellipsoid is unknown. Its outstanding characteristic is its affinity, in the visual cells of all vertebrates excepting the cones of the majority of snakes, for acid fuchsin dye. The ellipsoid has been claimed to originate embryologically from mitochondria, but the evidence is not of the best. Functionally, it appears to be dioptric, and no other significance has ever been attached to it since the abandonment, years ago, of Krause's idea that it was an end-bulb of a visual neurofibril.

The main body of the inner segment forms as a protrusion of cytoplasm from the distal end of the primordial columnar cell, the proximal end differentiating early into the footpiece. This protrusion grows beyond the level of the future limitans, and the nucleus remains behind, being locked in place by the constriction of the lacunae of the limitans (Culler and Walls). The junction of inner and outer segments is thus the original free border of the ancestral ependymal cell.

The marked differentiation of the nuclei of human rods and cones has long been known. The nucleus of the cone is slightly larger, tends to be more strongly ovoid and abuts on the limitans. The smaller, more nearly spherical nuclei of the rods form several layers because of their great numbers and the slenderness of their cells, and only a few of them touch the limitans between the nuclei of the cones. This situation is characteristic of the lowest and highest vertebrates but does not obtain in Amphibia, in which the nuclei are shaped alike and the nuclei of the rods all touch the limitans.

Menner (1929) called attention to a difference in the distribution of chromatin: The nuclei of the cones have a large number of small chromatin masses on a linin reticulum, while the rods possess fewer,

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7. Several of the students of histogenesis cited in preceding footnotes were struck by the similarity of the modes of development of outer segments and sperm tails. None, however, seems to have thought of ependymal cells in this connection, and Studnička seems to have been entirely ignorant of the literature on histogenesis.

larger pieces without linin.[8] This difference holds except for the lampreys, amphibians and reptiles. It perhaps has some functional significance, though probably not so direct a relation to cone vision versus rod vision as Menner supposes.

A striking differentiation of the footpieces ocurs as well (Greeff, fig. 30). The cone fiber is heavy and dendritic; the rod process, filamentous and knobbed. This end-knob of the rod was considered primitive by Greeff, who saw the dendritic terminus of the footpiece of the cone as a higher modification; but if the visual cells were once ependyma, the dendritic ending must be regarded as the primitive one. The small ending of the rod can then perhaps be considered adaptive to the formation of multiple bipolar connections in a compact fashion. At least, the smooth end-knob is characteristic of those animals whose rods greatly outnumber their cones. It is lacking in the rods of Amphibia, whose footpieces, like their nuclei, are conelike.[9]

LOCUS OF RECEPTION

The linear chromatic aberration of the human eye being greater than the thickness of the retina, it is erroneous to speak of a retinal level at which the image lies. The problem involved is the same whatever way it is expressed: At what level of the retina does reception take place? Which organelle of the visual cell is the percipient one, capable of converting photic energy into a nerve impulse?

Experimental attempts at this determination were made as early as 1844 and depend on entoptic phenomena (Purkinje's vessel shadows) for their success. Crude at best from a histologist's standpoint, the parallax method leaves one unable to select any one level between the outer nuclear layer and the tip of the outer segment.

Other lines of attack have derived from the reasoned functions of the elements of the cells. Thus Krause favored the ellipsoid because he believed that he could trace neurofibrillae to it, and Menner, believing that a certain stock of mice which have outer nuclei but no visual cytosomes (the recessive character "rodless" of Keeler) had been shown conclusively to have visual capacity, thought that the nucleus might even be the percipient structure. The best evidence of this sort

8. The reader will recall the old controversy as to whether the mammalian (and human) rod nucleus had its chromatin arranged in disks. Such an appearance is never given by modern technics.

9. It is perhaps a coincidence, or perhaps (coupled with the reputed presence of an oil droplet in the rod of the immature frog and the conelike form of the latter [Detwiler and Laurens]) an indication either of an immediate secondary cone ancestry for the rod of the amphibian (see Walls) or of a complete primitiveness of the retinal histogenesis of the amphibian, paradoxically exceeding that of all lower forms.

is heavily on the side of the outer segment. One must look for it, however, in the lower vertebrates. Large numbers of animals have in each of their cones a large droplet of brightly colored oil, the function of which is that of a color filter which operates to sharpen the retinal image (Walls and Judd). This droplet lies in the sclerad end of the inner segment, so that the light which is filtered by it has then only the outer segment to traverse.

That the outer segment is the receptive structure is again indicated by the fact that it is small in diurnal animals and huge in their nocturnal relatives whose visual cell patterns are otherwise identical, the greater volume resulting in greater sensitivity which is reflected in the difference in habits (Walls).

These indications are in complete harmony with the view that the visual cell is a sensory ependymal cell. The outer segment being the modified flagellum,[10] it is rather to be expected that it, like the "hairs" of sensory hair cells in general, should be the locus of reception. To allocate reception further, to the peripheral centrosomic fiber, the myeloidal spirals, etc., as some are inclined to do, is impossible at the present time.

VISION PER SE

The seemingly impregnable duplicity theory expresses the physiologic contrast of rod and cone. The rod population is concerned with achromatic vision and, when dark-adapted, is very sensitive, but it yields only hazy central images because of the summation (in bipolars and ganglion cells) which helps materially to confer the sensitivity. The cones afford chromatic and achromatic sensations and function only in brighter light. They yield detailed subjective pictures, since they are summated less throughout the retina and not at all in the fovea.

The assumption that rod vision is a simpler process than cone vision is scarcely justified,[11] but so long as this is understood there will be no harm in considering first the behavior of rods. These cells are remarkable for their capacity for dark-adaptation—a phenomenon so complex in all its aspects as to have given rise to an extensive literature, which has recently been most ably reviewed by Adams. This capacity is greatly impaired by a deficiency of vitamin A, which is

10. In this connection, most interesting comparisons are of figure 3, h of Franz (1912) with figure 7 of Lebоucq, and of figure 20 of Seefelder with figure 457, b of Maximow.

11. This common assumption, first made by Max Schultze, is a corollary of the theory that the rod is the more primitive visual cell and the cone a more complex derivative of the rod. There is not a shred of evidence for this theory, though it has never been questioned and has been made the basis of a prominent theory of color vision, that of Mrs. Ladd-Franklin.

believed either to retard the formation of rhodopsin (visual purple) or to diminish the maximum amount producible, probably the latter.[12]

It is the formation (not "regeneration") of rhodopsin in dim light which constitutes by far the most important factor in promoting the great sensitivity of the scotopic rod. Interest in rhodopsin, dormant since the heyday of the Heidelberg school led by Kühne, is now reviving.

The nature of the photochemical process involved in vision has been hypothesized by Hecht on the basis of analyses of photoreceptory phenomena in man and animals.[13] Not much has been added to his masterly treatment, though Wilcox (1932) and Wilcox and Purdy have criticized Hecht's theory of a random distribution of visual cell thresholds accounting for the increase of visual acuity with illumination.[14] Some other subtractions may need to be made when more is learned of the behavior of rhodopsin. Hecht formerly believed this to be the essential photochemical substance of vision, not only in rods[15] but also in cones, where a trace of rhodopsin was assumed to occur. He no longer involves the cone in these assumptions, but still considers rhodopsin essential for rod vision.

Another attitude toward rhodopsin considers it merely a sensitizer the static presence of which in the scotopic rod, because of its color and coloredness, promotes sensitivity tremendously by absorbing small amounts of light and converting them efficiently into chemical energy available for the activation of the bipolar. It is not surprising that the curve of bleaching of rhodopsin in monochromatic lights and the absorption spectrum of its solutions should agree closely with the curve of

12. The exact mechanism involved is being studied by Miss Tansley, who has already (1931) demonstrated concretely the diminution of rhodopsin in dark-adapted A-avitaminotic laboratory animals, and seems to have finally established (1933) that rhodopsin is produced within the outer segment of the rod, not absorbed from the pigment epithelium as has long been thought.

13. The reader should consult Arey (1932) for a discussion of various theories other than the purely photochemical, all of which (so far proposed) are untenable on one ground or another. The most radical idea in all modern ophthalmology is that of Fortin (1926), who denies a visual function to the rods and cones and claims to have discovered a new layer at the level of the end-knobs of the rods, not histologically demonstrable, which he believes to be the true level of perception on the basis of entoptic phenomena. Fortin thus goes Edgridge-Green one better, for the latter denies a visual function only to the rods.

14. But see Hecht and Wald.

15. It will be recalled that Edridge-Green's theory of vision posits large amounts of rhodopsin in cones (it having diffused out of the rods, the sole function of which is to secrete it), where it is essential for vision. This theory is at once rendered untenable when the pure-rod and pure-cone retina of many lower animals, notably certain reptiles, are taken into consideration.

luminosity of the scotopic spectrum, for even if rhodopsin is simply a sensitizer, it will still be very much the determinant of the behavior of the entire scotopic retina.

According to this view, the bleaching of rhodopsin in bright light is not essential for its sensitizing action—an inert pigment would work as well there as does erythrosin in a photographic emulsion—but is a happy adaptation for the prevention of intolerable dazzle. Hecht's well known fundamental equation $S \rightleftarrows P + A$ may well hold for the initial change of the essential visual substance, but it is not at all certain that rhodopsin is that substance, even for the rods, and there are at least some types of cones which, it would seem, contain not the slightest trace of rhodopsin (Walls).[16]

Rod vision is assuredly brute in character, but to label it "dyscritic" and dismiss it as primitive,[17] as Parsons (1927) does, conceals the fact that the diffuse character of rod vision represents a deliberate and probably secondary sacrifice of visual acuity for the sake of added sensitivity. Actually, the little real evidence available points to the cone as the more primitive visual cell, and the steps in the manufacture of rods from cones can actually be seen in extant kinds of animals (Walls).

COLOR VISION

Under this heading I can scarcely attempt a survey of the myriad of hypotheses which have been formulated, but I must at least consider some which involve definite cytologic features in an explanation of chromatic reception.

Physical theories of color vision have little plausibility. The one which has had the longest and most prominent history, and of which the most recent champion was Raehlmann, has just been modified and revived by Karbowski. Based on the disks of material in the outer segment (which I have noted are probably nonexistent), Karbowski's theory explains most color vision phenomena, if allowed to make two

16. Kolmer (1925) considered that he had demonstrated rhodopsin in the foveal cones of the chimpanzee by producing on them the droplets which he and Detwiler (Kolmer, 1909 and 1914; Detwiler, 1923) decided represent the photopic phase of rhodopsin, the scotopic, active phase having histologic representation in the cross-striated disk appearance of the dark-adapted outer segment when fixed and stained in a prescribed manner. This mutual exclusiveness of the "droplets" and the "striations" is interesting, but a relation of these phenomena to each other or of either to rhodopsin is unlikely. I consider "Kolmer's droplets" to be artefacts and have yet to see them in sections of any type of retina embedded in pyroxylin and stained as Detwiler recommends.

17. Duke-Elder goes so far as to suggest that the rods have no cortical representation, but Henschen has recently described two types of cortical visual cells which he relates respectively to the rods and cones of the retina.

assumptions: (1) The disks are tuned, each resonant to a particular frequency, the red end of the spectrum being perceived by the disks at the tip, the violet by the ones at the base of the outer segment; (2) the cone myoid has a range of contraction and elongation of 225 microns in light and darkness.

Apart from the precarious reasoning concerning the "disks," this theory is invalidated by the assumption of migration of the cones alone, for no such phenomenon has been detected in the human retina, and even if it occurs it would have been noticed long since if the distance of migration even approached the thickness of the entire retina—a distance several times that covered by the exceedingly mobile cones of the frog.

The three component theory of color vision has never yielded in popularity to any other, and some of the strongest objections of long standing have been recently removed by Hecht.

Young originally proposed three sets of nerve endings—one would say today, three kinds of cones—each responsible for one of three peaks of sensitivity into which the hue-discrimination curve can be resolved by experiment and by analyses of color blind types.[18] An attempt to apply the Young-Helmholtz theory to the single type of cone which is histologically demonstrable in man was once made by Schenk, who was misled by an old description (by Hasse) of a trifurcation of the footpiece of the cone into thinking that these three branches (soon shown to be nonexistent by Wetzel) mediated the three *Urfarben* demanded by the theory.

Statements of the theory which posit three physiologically distinct (but histologically indistinguishable) types to cones have had much more favor. The well known fact that visual acuity is even higher in many monochromatic illuminations than in an equivalent white light[19] shows at once that every cone must respond alike to the whole photopic spectrum, else in a monochromatic light, with two thirds of the cones necessarily out of function or operating most inefficiently, cone vision would be as diffuse as rod vision.

The three or more photochemical substances which exist in the cones must then all be in each cone. The mechanism by which a single

18. A peculiar variant of this idea is advanced by Roaf, who suggests the presence of three undiscovered types of intracellular color filters in human cones. Roaf considers that these filters, comparable or even identical with the oil droplets of birds, accomplish the differentiation of chromatic stimuli. The oil droplet mosaic of birds is not, however, responsible for their color vision, nor will any such filters ever be found in human retinas.

19. It is higher because of the elimination of chromatic aberration. The human eye is not provided with so effective a device for combating this defect as are the eyes of many animals (Walls and Judd).

cone informs the brain of the reception of different wavelengths must be in essence a modulation of the discharge frequency of the opticus fiber involved. Further than this, the students of action currents and the psychologists will have to be the guides. It is not the initial photochemical changes in vision, but the multiplicity of subjective phenomena which offers the greatest difficulty to inclusive visual theories.

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Obituaries

WILLIAM CAMPBELL POSEY, M.D.
1866–1934

In the fall of 1892 there returned to the city of his birth, from his studies abroad, a young man richly endowed in mind and in mien who was destined to play a distinguished part in American ophthalmology, Dr. William Campbell Posey.

Dr. Posey was born in Philadelphia, in the neighborhood of Twelfth and Arch Streets, on July 5, 1866, the son of Dr. David Root Posey and Emily Jewel Campbell Posey. On his father's side he was a descendant of Francis Poschet of France, who migrated to England and from there came to America and settled in St. Mary's County, Md., in 1637. For many generations Dr. Posey's immediate paternal ancestors lived in Chester County, Pennsylvania. On his mother's side his ancestry was Scotch-German. The Campbell family have lived in Philadelphia for many years. In 1910 he married Hadassah Felton, who, with three children, survives him.

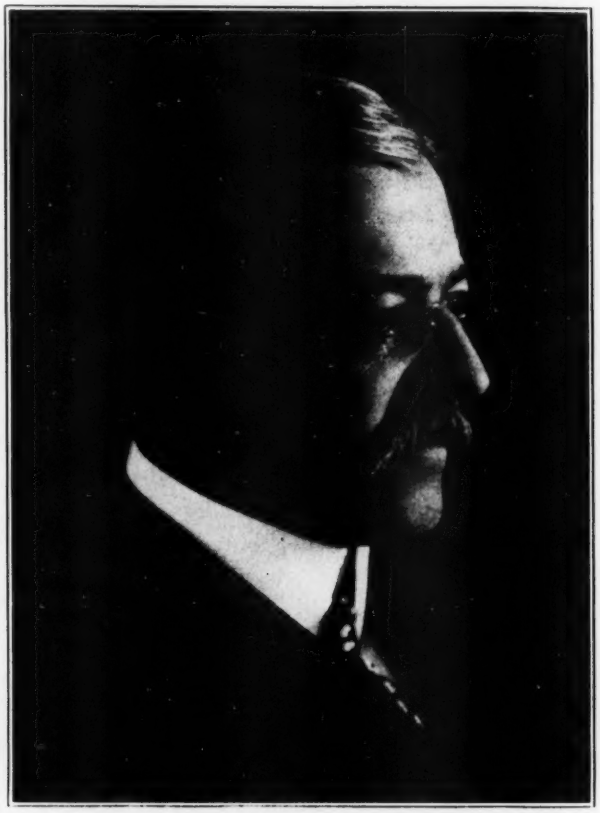
His preparatory education was received in the Episcopal Academy, Philadelphia. From there he entered the college department of the University of Pennsylvania, receiving the degree of A.B. in 1886. He then matriculated in the medical department and received the degree of M.D. in 1889.

His popularity and the esteem in which he was held while at college is attested by the many honors bestowed on him by his classmates. He was Bowl Man, business manager of the *Pennsylvanian* and president of the Athletic Association, of the Intercollegiate Association and of the class football team. He was a member of Phi Kappa Psi and of the Philomatrian Society. While a student in the medical department, he was president of the Stillé Society, and on graduating he received the Anomaly prize.

He served his internship at the Presbyterian Hospital, and on its completion went abroad to study languages and ophthalmology. In pursuit of his studies he displayed an earnestness and oneness of purpose coupled with an intelligent application which were recognized and won for him the lasting friendship of his teachers, among whom were Collins, Hirschberg and Panas. He was particularly happy at Göttingen, where he was a student during the winter of 1890-1891, and he cherished a deep affection for his teachers and the kindly folk of that ancient seat of learning. In 1894, together with Smith, John Marshall, Ford, Davis, Hoch and Kneas, he formed the Göttingen Society. He was the last living founder.

Soon after his return from abroad he conducted a most successful quiz in ophthalmology as one of the masters in the Medical Institute.

Having a host of friends and a wide circle of acquaintances, Dr. Posey rapidly, one might say almost at once, acquired a large practice. In the course of a few years Dr. W. C. Swindells became associated with him in his office and remained with him until he retired from practice.



WILLIAM CAMPBELL POSEY, M.D.
1866–1934

His clinics were well organized, so that he could give most of his time to the patients in the wards and to operating. He was an alert clinician and worked rapidly.

As an operator, Dr. Posey was skilful and resourceful, and quick to adopt new methods. He was one of the first in this country to perform the Krönlein osteoplastic resection of the outer wall of the orbit and to put into practice the suggestion of Duane that tenotomy of the inferior oblique muscle is indicated for the overaction of this muscle in paresis of the superior rectus muscle of the opposite eye.

Dr. Posey had many hospital connections. At the Wills, Howard and Children's hospitals he had active service, and he was at various times visiting and consultant surgeon to the Wills, Chestnut Hill, Abington Memorial, Norristown State, Wernersville and Westerly (Rhode Island) hospitals. He was for many years professor of ophthalmology at the Philadelphia Polyclinic and Hospital. During the World War he served on the Draft Exemption Board.

He was a Fellow of the College of Physicians (and past chairman of its Section on Ophthalmology) and of the American College of Surgeons; a member of the state and county medical societies (and past chairman of the Section on Eye, Ear, Nose and Throat of the state society), the American Medical Association (of which he was past chairman of the Section on Ophthalmology), the American Ophthalmological Society (of which he was past president), the American Academy of Ophthalmology and Otolaryngology and the Ophthalmological Society of the United Kingdom, and he served as a member of the Board of Directors of the National Society for the Prevention of Blindness.

He was a member of the University Club, the Marion Cricket Club and the Radnor Hunt Club.

As chairman of the Section on Ophthalmology of the American Medical Association, 1909-1910, Dr. Posey suggested to the Executive Committee of the Section the establishment of a fund to be known as the Herman Knapp Testimonial Fund. The purpose of the fund was to further the progress of ophthalmology and to honor one of the foremost ophthalmologists of the world. The fund is still active.

Dr. Posey's address as chairman was on "The Visual Requirements in the Public Services of the United States." Only a perusal of this report can convey the thoroughness of his investigations, which included a study of the visual standards in force by the government of the United States and by the government of Great Britain and of Germany. Characteristically, he stated: "Anticipating some action by the section I have already done what I could to establish better standards."

As chairman of the first State Committee on Conservation of Vision, he planned a comprehensive campaign for the prevention and treatment of ophthalmia neonatorum, enlisting the cooperation of ophthalmologists throughout the state.

He early became a contributor to the literature, and published about one hundred and thirty articles, principally clinical, covering practically all phases of ocular disorders.

Of these contributions, four are of outstanding merit: "The Treatment of Chronic Simple Glaucoma by Miotics," "The Ocular Symptoms of Affections of the Accessory Sinuses of the Nose," "Vernal Conjunctivitis" and "Congenital Squint."

I need speak here only of Dr. Posey's advocacy of more general use of miotics in the treatment of chronic simple glaucoma. When all about him were urging early resort to operation, it took courage to advocate a mode of treatment of which a famous ophthalmologist had said that it did more harm than good because it deferred the inevitable operation to a stage of the disease when conditions were no longer favorable for its performance. Dr. Posey's contention was supported by the results obtained with miotics in a large number of patients whose vision and field had been well maintained over a long period of time. Who is there that can speak with authority and certainty, by presenting stronger proof of the efficacy of operative procedures, and say that he was wrong?

It was in the masterly paper on congenital squint, in which are given the histories of seventy cases, that Dr. Posey reported on the performance of tenotomy of the inferior oblique muscle to correct the upshoot of an eye in adduction.

He edited and wrote a number of books. "A Treatise on Diseases of the Eye" was the first volume of a series on diseases of the eye, nose, throat and ear edited by him in collaboration with Jonathan Wright in 1903. The various chapters were written by men who had previously demonstrated their special ability in connection with the subject assigned. Dr. Posey wrote the chapter on "Examination of the Eye."

In "The Eye and Nervous System: Their Diagnostic Relation, by Various Authors," edited by Dr. Posey and W. G. Spiller in 1906, Dr. Posey contributed the chapters on "Exophthalmic Goitre" and "The Psychologic Effects of Operations on the Eyes."

"The Wills Hospital of Philadelphia: The Influence of European and British Ophthalmology Upon It and the Part It Played in the Last Hundred Years in Developing Ophthalmology in America," by Dr. Posey and Samuel Horton Brown (1931), published in commemoration of the one hundredth anniversary of the founding of the Wills Hospital, was, on the part of Dr. Posey, truly a labor of love. Although he had severed his active relations with the hospital in 1919, his interest in it remained unabated until his end. The scope of the book is comprehensive and is much more than its title conveys. It includes a survey of the development of ophthalmology as a specialty, a concise and critical biographical sketch of all the surgeons who had served Wills Hospital and were no longer living, a bibliography of the work of the members of the staff, a history of the pioneer opticians of Philadelphia and much other related matter.

Dr. Posey wrote "Hygiene of the Eye" in 1918.

In 1900 he revised and edited the sixth edition of "Diseases of the Eye" by Edward Nettleship.

Textbooks are ephemeral; so of the several volumes with which Dr. Posey's name is associated the history of the Wills Hospital will longest endure.

Because of essential hypertension in 1919, Dr. Posey was obliged to curtail his work and resign from his hospital and teaching positions; in 1926, following obstruction of the superior temporal vein of the retina of the left eye, he retired from active practice.

For a man of whom it might be said, as said of another, "the sixteen hours' day, the pride of overwork, had been his life," this sudden letting down might have led to despondency, but Dr. Posey met it with a brave spirit and fortitude and at once interested himself in other pursuits, and with former associations in a less strenuous way, so that this period of his life was none the less productive. He engaged actively in welfare, committee and literary work. The history of the Wills Hospital and the history of the Göttingen Society and several memoirs belong to this period. During this time Dr. Posey also served as president and later as a councilor of the American Ophthalmological Society. He attended regularly the meetings of the National Society for the Prevention of Blindness in New York, took an active part in forming anew the State Committee on Conservation of Vision and was chairman of the Philadelphia County Branch of this committee. His family affairs also demanded much of his time.

Soon after his marriage Dr. Posey made his home in Radnor, where he loved to entertain his more intimate friends. In his younger days he usually spent his summers in the Engadine and Tyrolean Alps where, with his friend Dr. Paul Van Dyke of Princeton University, he enjoyed mountain climbing and tramping. In his middle years he spent the summers at his home at Watch Hill.

Dr. Posey was a lover of music, especially orchestral. At home he found further musical enjoyment in his wife's skilled performance on the piano.

He was an excellent judge of men and their aims and was outspoken in criticism or generous in praise, as the case warranted. He had a friendly, sociable nature, and a genial wit enlivened his conversation. He possessed a forceful, compelling personality and rarely failed to accomplish his end, which fortunately was always for the best interests of medicine. He was a splendid organizer; a committee of which he was chairman was certain to attain its object in the shortest possible time and with the utmost thoroughness, and the report usually reflected the chairman's point of view.

He was most generous and gave largely to the many charities with which he was connected. He worshipped in the Presbyterian Church, in the mission work of which his mother was active.

Dr. Posey's outstanding attributes were forcefulness, geniality, frankness, loyalty, generosity and magnamimity. He was a clinician of keenness, a surgeon of skill and judgment, an author of distinction and an administrator of capability.

My earliest association with Dr. Posey was at the Wills Hospital, where he held the position of assistant surgeon in the service of Dr. C. A. Oliver (1893), I having a similar position in the service of Dr. W. F. Norris (1890). Soon after this, in 1895, we collaborated on our first paper, "A Study of 167 Cases of Chronic Glaucoma." We had the satisfaction not only of having this paper accepted by Dr. Herman Knapp, a most exacting and critical editor, but of receiving a congratulatory letter from him. After we both became attending surgeons it was rarely that either of us performed a difficult operation without the cooperation of the other. Our intimate friendship endured to the end.

Dr. Posey's desire to share with his family the pleasure and profit of foreign travel caused him to overstep the bounds of prudence which his condition called for. It was thus that he met with death from a cerebral hemorrhage on Sept. 5, 1934, at Naples, Italy, as he was returning home with his family, whom he had joined shortly before.

Dr. Posey rests in the churchyard of the Old St. David's, Radnor, Pa.

Our lives are rivers, gliding free
To that unfathomed, boundless sea
The silent grave!

W. ZENTMAYER, M.D.

It was a great shock when I heard of the death of my old friend William Campbell Posey. He had made a great name for himself in ophthalmology, not only in America, but all over the world. We first met at Moorfields Eye Hospital in 1892, where we worked together during the mornings in the clinic. He was then not only an able but also a most industrious and painstaking worker; he allowed nothing to interfere with his work, so that the position he ultimately gained was what one expected from early associations with him. After a hurried lunch, we continued our work in the afternoon at Westminster Ophthalmic Hospital.

Dr. Posey and his wife and family were most charming in their home circle. I had the pleasure of seeing them in their home in Radnor when I attended the American Ophthalmological Congress in 1922. I also met Dr. Posey in London in 1925, at the Convention of the English-Speaking Ophthalmologists after the war, where we spent considerable time together. The last time we met was at the International Ophthalmological Congress in Holland, where he was the center of a circle of friends. However busy he was, he always had plenty of time

to spend with his friends. He did his best to make things pleasant for every one. Unfortunately, circumstances prevented us from meeting since then, but we were in continual correspondence.

Others are more competent to speak of his work for ophthalmology, both as a practitioner and author, and I think it better for me to leave this to those more able to do him justice and to confine my remarks more to Posey the man than to Posey the ophthalmologist. He was a man of deep religious convictions, but he never obtruded this subject.

The passing of William Campbell Posey is a loss to ophthalmology, and not only to ophthalmology, for the world is poorer for his passing. He leaves a blank among his friends which can never be filled, and the sincerest sympathy and condolences of ophthalmologists all over the world go out to his wife and children.

JOHN ROWAN, M.B., C.M., F.R.F.P.S.G.

Though his health had been affected for some years, the sudden death of William Posey came as a great shock to his many friends, who are left with a sense of irreparable loss. By his death American ophthalmology has suffered a severe loss, and the medical profession, the loss of a dominant personality.

Dr. Posey received his special training in Germany and England and remained faithful to the memory of his early teachers, keeping an open and fair mind during the World War and the strenuous years that followed. His operative skill and diagnostic ability were outstanding; from the outset his career was brilliant, and he rapidly rose to eminence in his specialty. At medical meetings he contributed many important papers on subjects dealing with diseases of the eyes, and always took an active part in the discussions. He was one of the first to recognize the relation of the nasal sinuses to diseases of the eye and of the orbit, and was always interested in the association of nervous diseases with the eyes.

Of signal courage, Dr. Posey was ready to support and fight for what he thought was right. He was whole-heartedly devoted to his specialty, and his interests lay always in what he thought to be the best interests of ophthalmology; thus his interest in the Section on Ophthalmology of the American Medical Association remained unflagging. Together with his friend the late Dr. A. E. Bulson, he created a fund designated as the Knapp Testimonial Fund, in memory of Dr. Herman Knapp, subscribed to by members of the Section, which permitted the Section to enlarge its usefulness and service.

Outside of his professional work Dr. Posey was a great reader and a student of early American history, particularly the early history of

his native state. He was fond of the out-of-doors, and always enjoyed horseback riding and walking.

After his retirement from active practice, on account of ill health, he continued to attend medical meetings, was very active as one of the directors of the National Society for the Prevention of Blindness and served on the council of the American Ophthalmological Society; but what gave him the greatest satisfaction was the writing and publication, with Dr. S. H. Brown, of the history of the Wills Eye Hospital, in which he gave a sympathetic review of American ophthalmology, just as his great friend, E. Treacher Collins, had done for the Moorfields Eye Hospital of London.

To me his wisdom in counsel and his sympathy made him an invaluable friend, and his death leaves a sad blank.

He leaves a widow, a daughter and two sons with whom widespread sympathy is felt in their bereavement.

A. K.

Correspondence

DIVERGENCE EXCESS

To the Editor.—Allow me to make some remarks in reply to Dr. Marlow's letter in the October number of the ARCHIVES.

I fully appreciate the value of the very interesting results obtained by Dr. Marlow with the occlusion test. In previous publications I have tried to explain the reasons for the difficulties which we find in ascertaining the real (anatomic) position of rest. But also in testing the relative (functional) position of rest in one and the same case the amount and kind of phoria may vary considerably if the patient is tested at different times and under different or even equal conditions. In the face of such experiences Dr. Marlow recommended the prolonged occlusion test of one eye in order to make a possible phoria manifest. He was led to this test by the fact that squint develops in the great majority of patients with amblyopia or amaurosis of one eye due to disease or injury. As a rule, the deviation increases gradually up to a certain degree before it becomes constant. Only then has the true (relative) position of rest been revealed. After Abraham and Beisbarth (1932) had published the results obtained by the alternate occlusion test, Dr. Marlow examined 82 cases in the same way. He found that the prolonged occlusion test in a high percentage of such cases revealed not only different amounts but different kinds of phorias, according to whether the right or the left eye had been occluded. In 49 out of 82 cases Dr. Marlow found as a result of the alternate occlusion, hyperphoria of the same kind but of different degree; in 23 cases there was also a different type, each eye, when covered, going upward. Similar conditions were found in exophoria and esophoria. In 16 patients who first had the left and later the right eye occluded, the amount of exophoria found by the first test was reduced by the second one. In one case esophoria by the first occlusion was diminished from 10° to 6°, whereas the occlusion of the second eye produced an increase to 15°, i. e., a higher amount than that which was found by the pre-occlusion examination. From these results we must conclude that the prolonged occlusion test does not cause the innervation which influences the position of the eyes relative to one another to disappear. To exclude such innervations as far as possible in order to obtain, approximately, the true relative position of rest as a basis for the treatment of heterophoria we must either have one of the eyes occluded for months, or we must look for another method of investigation. There is no method more reliable, at least in my opinion, than the duction power test, if it is performed very carefully and is repeated several times. The results thus obtained vary only within narrow limits, so that they give a fairly reliable basis for therapeutic procedures. However, this must be discussed more fully than is possible by letter. I am therefore preparing a paper on heterophoria, to be published in the near future.

A. BIELSCHOWSKY, Hanover, N. H.

News and Notes

GENERAL NEWS

Treacher Collins Memorial Fund.—The Treacher Collins Memorial Fund, built up by voluntary donations, is being sponsored by the Ophthalmological Society of the United Kingdom. Proceeds from the Fund will be devoted to the promotion of original work by younger members of the specialty. Subscriptions should be sent to Sir Arnold Lawson, 12 Harley Street, London.

Status of Optician in Europe.—In the *Revue internationale* for May 1934 there are published the answers from seventeen European countries to a questionnaire submitted by the secretary of the French Association of Oculists. The questionnaire dealt with the training and legal status of the optician and with the relations between opticians and the medical profession. The period of education of opticians averages about three years, in seven countries by organized education, and in nine countries by apprenticeship. The practice of testing sight is open to anybody in all countries except Austria, Germany, Norway, Canton Vaud and Bulgaria, where a diploma is prerequisite to practice. In Germany, the optician may not give glasses to children or to persons suffering from disease except on prescription from a physician. A medical prescription is universally required for glasses in Bulgaria and Danzig. Only in Sweden and Great Britain is there a national Association of Dispensing Opticians, members of which pledge themselves to supply glasses only on medical prescription. Only in Great Britain is service provided by the state for testing the sight of school children. Service of this type is provided in Berlin and Munich.

Folia Ophthalmologica Orientalia.—The first three articles in the July-Sept. 1933 number, volume 1, part 3, of this journal have to do with details of trachoma. Cuénod and Nataf of Tunis make the point that biomicroscopic study of pure trachoma can serve to differentiate between the follicle and the papilla. The former, essentially a lymphoid element, represents a reaction against the virus of trachoma. The papilla, essentially a vascular element, represents a reaction to the irritation caused by follicles.

Meyerhof of Cairo does not believe that follicular conjunctivitis is a form of trachoma, although the conditions may begin similarly.

Busacca of Brazil, from histologic examinations of trachomatous corneas, argues that the virus of trachoma has a definite affinity for epithelial tissue. He regards pannus as a special granulation tissue, which, consequent to an infectious process, has formed in normally avascular tissue.

There are three other clinical articles. Dr. Spiratos of Athens gives a short account of five cases of external ophthalmomyiasis, a conjunctival reaction caused by the larvae of the Oestrus ovis. Dr. Pagès of Morocco describes a case of amebic dysentery in which several recurrences were complicated by iridocyclitis which could not be

attributed to any other cause. Both conditions yielded to treatment with emetine. Dr. Meyerbach of Aachen records a case of retinitis pigmentosa in which some improvement occurred after prolonged treatment by subcutaneous and oral administration of an ovarian product according to the method of Wibaut.

This number also contains the second portion of Strathearn's article on the problem of blindness in Palestine, an article tracing the development of ophthalmology in Turkey in the last fifty years by Ismet and Alexiadeó (Istanbul) and a fair number of abstracts and reviews.

The booklet contains 87 pages, and the price is 3 shillings. It is edited by Aryeh Feigenbaum, Jerusalem.

UNIVERSITY NEWS

Prof. A. Bielschowsky of Breslau has accepted an invitation to work for six months in the Department of Research in Physiological Optics at Dartmouth College.

SOCIETY NOTES

Paris Ophthalmologic Society.—The meeting of the Paris Ophthalmologic Society was held on Nov. 18, 1934. Professor Strohl of the Medical Faculty spoke on the biologic and therapeutic effects of the roentgen rays and radioactive substances. Dr. Mawas delivered a report, "Introduction to the Study of Myopia and Myopic Chorioretinitis." An attempt is being made to organize a group to study the question of detachment of the retina.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

COURSE OF OPTIC RADIATION IN MAN. MANUEL BALADO and ELIZABETH FRANKE, Arch. de oftal. de Buenos Aires **8:** 363 (Aug.) 1933.

After an extensive and detailed review of the literature and the present knowledge of the subject, with numerous references to prior work and reported cases of their own, Balado and Franke report two new cases: one of a posttraumatic cerebral abscess involving the left occipital lobe and the calcarine fissure, and one of softening of the right cerebral hemisphere, in both of which serial sections were studied. The article is illustrated by a large number of photographs.

They conclude that: 1. The optic radiation in man springs from the external geniculate body and passes almost directly to the calcarine fissure and the pole of the occipital lobe. 2. The dorsal portion of the optic radiation springs from the anterior three fourths of the inner half of the external geniculate body. 3. The horizontal systematization of the optic radiation and sector degeneration of the same are confirmed by clinical reports. 4. The temporal flexure (knee) and Pfeiffer's *Zipfelmütze* have not been proved from an anatomicofunctional point of view. 5. The existence of the fasciculus cruciatus is hypothetic. 6. The disappearance of macular vision in a hemianopic field indicates a severe lesion of the corresponding geniculate body. 7. For the study of the visual pathways from an anatomicofunctional point of view quantitative perimetry and anatomic methods of investigation of fatty lesions are necessary.

C. E. FINLAY.

Bacteriology and Serology

SOURCE OF STAPHYLOCOCCI ON NORMAL CONJUNCTIVA OF HUMAN EYE. G. H. GOWEN, Am. J. Ophth. **17:** 36 (Jan.) 1934.

Gowen describes his experiments and gives the following conclusions: "1. Except for the influence of a factor not ordinarily present, the skin of the upper eyelid is not a source of contamination to the upper lash and plays no part in conjunctival contamination. 2. The skin of the lower eyelid serves as a heavy source of contamination to the lower lash. 3. Contamination occurs readily from upper to lower lash and vice versa, but the more rapid disappearance of organisms from the lower lash suggests a mechanical removal by the action of the upper lid. 4. As long as organisms are present on the lower lash in sufficient numbers, they can be recovered from the conjunctiva, but with the disappearance of organisms on the lower lash, conjunctival contamination ceases. 5. The fact that staphylococci are constantly present in the conjunctiva is due to the continual contamination of the lower lash by the skin, facilitated by nictitation, and mechanical introduction into the

conjunctival sac by the action of the upper lid. 6. It is evident that a field devoid of staphylococci can not be obtained in the conjunctiva inasmuch as the source of contamination is always present."

W. S. REESE.

Conjunctiva

LYMPHOID HYPERTROPHY OF THE CONJUNCTIVA WITH OPALINE FOLLICLES. C. DEJEAN, Arch. d'opht. **50:** 801 (Dec.) 1933.

Dejean describes three quite similar cases of a condition sufficiently distinctive to merit the denomination of lymphoid hypertrophy of the conjunctiva with opaline follicles. It is characterized clinically by a hypertrophy of the conjunctiva in large opaline swelling and histologically by a hyperplasia of the normal lymphatic tissue and an increase in the number of round cells. It persists for months. Its onset may be acute or may extend over a short period of time. The symptoms in the beginning consist of itching, tearing, a heavy feeling, secretion and some pain. This is followed by the more lasting phase. The appearance of the conjunctiva is so distinctive that the involvement cannot be confused with any other. The surface of the conjunctiva is strewn with small translucent vesicles, swollen as if they contained air or fluid. The conjunctiva is greatly thickened and pale because of the follicles. It becomes very thick but is not indurated, the follicles being soft. A detailed histologic account of the condition is presented, and the differentiation from trachoma, follicular conjunctivitis, vernal catarrh, tuberculosis, syphilis and Parinaud's conjunctivitis is discussed. Dejean finds it difficult to fit this condition into Pascheff's classification of the hyperplasias. No treatment has been found which cuts the disease short. It clears spontaneously.

S. B. MARLOW.

Congenital Anomalies

THREE CASES OF COLOBOMA OF THE OCULAR MEMBRANES. E. LAZARESCU and D. LAZARESCU. Arch. d'opht. **50:** 760 (Nov.) 1933.

The authors discuss the three theories which have been proposed to explain coloboma. The ectodermic theory of von Szily best explains incomplete closure of the fetal fissure. Deutschmann's theory of inflammation best explains the atypical forms of coloboma. The first case presented is one of bilateral coloboma of the iris and choroid. The choroidal coloboma in the right eye included the optic nerve entrance. There was also a slight degree of microcornea. The second case is that of an atypical partial coloboma of the optic nerve involving the macula. The third case is one of an isolated coloboma situated in the superior temporal region of the left eye and having the appearance of a second, atrophic disk.

S. B. MARLOW.

A CASE OF CONGENITAL MEMBRANOUS ANKYLOBLEPHARON. C. CORDERO, Arch. di ottal. **40:** 369 (Sept.-Oct.) 1933.

In an infant of 39 days the middle portions of the upper and lower lids, over an area 4 mm. long, were connected by a thin membrane. No cilia were present on either lid. The membrane was excised, and sections showed it to consist of epithelium and vascular connective tissue containing muscle fibers and numerous subepithelial glands. The opening of the

palpebral fissure in new-born kittens was investigated histologically. The process begins with the formation of spaces filled with keratinized epithelium, usually surrounding a cilium. This keratinization of the epithelium begins at each end of the future palpebral fissure and extends toward the middle. As the cause of the anomaly in his case Cordero supposes an arrest of development of the epithelium and a growth of mesodermal tissue between the lid borders to form the membrane observed.

S. R. GIFFORD.

A CASE OF BILATERAL CONGENITAL HYDROPHTHALMOS, ACROCEPHALOSYNDACTYLIA AND OTHER MALFORMATIONS. P. J. WAARDENBERG, Klin. Monatsbl. f. Augenh. **92:** 29 (Jan.) 1934.

The detailed report of an unusual combination of congenital malformations is given and illustrated with nine photographs. A baby born at full term, weighing 2,770 Gm. and measuring 50 cm., the child of nonrelated parents, died with symptoms of cyanosis on the fourth day after birth. Hydrophthalmos of both eyes was noted, as well as ocular hypertelorism, the distance between the inner canthi measuring 32 mm., against a normal average of 22 mm. The corneas were opaque, and the limbus was ill demarcated from the sclera. Other malformations were acrocephalosyndactylia, "parrot's nose," cleft palate, badly developed mandible and chin, low-set and malformed ears, malposition of the clavicles, mitral stenosis, pseudohermaphroditism, cryptorchism and contraction of the elbow and knee joints.

Roentgenograms showed irregularities of the skull, hands and feet.

The case is discussed in comparison with other instances recorded in the literature, and especially in connection with the zoologic publication of Bonnevies, which seems to be supported in some respects by Waardenberg's case. Etiologic consideration is given the increased intracranial pressure which was present though the cranial sutures were open and the fontanels patulous.

K. L. STOLL.

Cornea and Sclera

KERATITIS BULLOSA. W. T. DAVIS, Am. J. Ophth. **17:** 24 (Jan.) 1934.

Davis classifies the types of bullous keratitis and reviews the literature mainly from the standpoint of etiology and treatment. He reports the case of a woman 61 years old with bullous keratitis. Conservative treatment and later iridectomy gave only temporary relief. Roentgen therapy was then tried, following which the patient was free from symptoms.

W. S. REESE.

THE QUESTION OF SILVER PIGMENT OF THE KAYSER-FLEISCHER CORNEAL RING. B. FLEISCHER and W. GELACH, Klin. Wchnschr. **13:** 255 (Feb. 17) 1934.

Following a short report of Gerlach and Rohrschneider in this same journal Fleischer and Gelach report on an investigation of the entire globe in a similar case of Wilson's disease, which they examined by a similar spectrographic method. No silver was found in the cornea, lens, vitreous or posterior part of the globe, and only copper, iron and zinc were found in the cornea, the last two in very minute amounts.

The amount of copper in the cornea was three times as great as that in the posterior part of the globe even including the lens. The investigation is submitted to show that silver does not enter into the make-up of the Kayser-Fleischer ring. L. L. MAYER.

HERPETIC KERATO-IRIDOCYCLITIS. I. LEVIN, Sovet. vestnik oftal. **3:** 403, 1933.

Levin reports a case of a severe general infection with herpes virus involving the eye and resulting in its blindness. A woman, aged 32, complained of general malaise and pain in the right eye. On the following day a severe headache and high fever developed, with herpes of the lips and of the mucous membrane of the mouth. In the upper quadrant of the right cornea exfoliation of the epithelium was present. The severe general symptoms lasted for six days, during which period a deep ulcer formed in the upper segment of the cornea. An iridocyclitis with hypopyon developed within the next two weeks, and the vision was reduced to perception of light. During one of the severe general attacks the ulcer perforated. In a few weeks the patient was discharged with beginning atrophy of the eyeball. There was no disturbance of the trigeminus nerve, history of malaria or positive blood culture. O. SITCHEVSKA.

THE TECHNIC OF PARTIAL PENETRATING CORNEAL TRANSPLANTATION. V. P. FILATOV, Sovet. vestnik oftal. **4:** 1, 1934.

Filatov discusses the importance of not injuring the lens with the crown of the trephine during corneal transplantation. In order to increase the resistance of the cornea to the pressure of the trephine Filatov uses sutures in the following way: Three fine sutures are pulled through the superficial layers of the leukoma so that a triangle is formed between them around the disk which it is proposed to excise. Two of the sutures are held at an angle of 45 degrees and stretched upward by the assistant; the lower one is held by the surgeon. The region between the sutures is thus made resistant to the weight of the trephine, and contact of the lens and cornea is prevented. The sutures are removed at the end of the operation. By the use of such sutures in four patients injury of the lens was avoided. Filatov's previous method of using an ivory plate in the anterior chamber for the prevention of prolapse of the vitreous is used only when the vitreous appears in the anterior chamber. Then two counter-incisions are made at the external and the internal edge of the staphyloma, the plate is put in at once, and the vitreous is pushed backward. O. SITCHEVSKA.

Experimental Pathology

OCULAR PHENOMENA FOLLOWING HEATING AND COOLING OF THE SUPERIOR CERVICAL GANGLION. L. TRISTAINO, Arch. di ottal. **40:** 49 (Feb.) 1933.

In cats, the ganglion was isolated and surrounded by a glass loop containing a wire which could be brought to the desired temperature of 37-65 C. The heating produced conjunctival hyperemia, diminution

of corneal sensitivity, paresis of the third eyelid, narrowing of the palpebral fissure and miosis. With a lower temperature (39 C.) the phenomena were very brief, while with a temperature of 65 C. the changes were more marked and persisted on an average twenty-four days. Miosis persisted longer than the other symptoms and was followed by mydriasis, which persisted as long as three months. The symptoms are those of sympathetic paralysis. When the homolateral eye was first atropinized miosis was delayed for seven days and persisted for four days. Previous use of physostigmine increased the miosis. The albumin content of the aqueous showed a marked increase after the ganglion had been heated to 55 C.—up to twenty times the normal—returning to the normal after about four days. After previous use of atropine the increase in albumin occurred but was much less, while after that of physostigmine it was greater than after heating alone. Sections of the ganglions in these animals showed swelling of the cells and degenerative changes.

Cooling the ganglion by means of the direct application of ice for from five to thirty minutes produced the same ocular symptoms as heating it, the duration of symptoms depending on the time during which the cold was applied.

No symptoms referable to stimulation of the sympathetic nerve were seen in any of the experiments.

S. R. GIFFORD.

EXPERIMENTAL RETINAL DETACHMENT. F. SPINELLI, Arch. di ottal. **40:** 404 (Sept.-Oct.) 1933.

By submitting an area of sclera to cold air (35-40 C.) for six seconds Spinelli produced retinal detachment regularly in dogs. Sections made after eighteen hours, three, ten and twenty-five days showed an infiltration of the sclera and choroid. Some choroidal vessels were much enlarged; others were contracted, with thickened walls. The retina was edematous and hyperemic, and its layer of rods and cones showed degeneration. A layer of exudate formed between the choroid and retina, but this was absorbed spontaneously, so that after ten days the retina was almost flat and after twenty-five days it had regained an almost normal color ophthalmoscopically. No holes in the retina were formed. The results are compared with similar ones obtained by Weekers after cauterization of the sclera. Such detachments, which are due to the inflammatory changes provoked, and which disappear spontaneously, he recognizes, cannot be compared with spontaneous detachment of the human retina.

S. R. GIFFORD.

General

NUPERCAINE IN OPHTHALMOLOGY. N. CHIEPPA, Ann. di ottal. **61:** 787 (Oct.) 1933.

Chieppa has used nupercaine (1 : 500) as an anesthetic with success in about fifty operations on the globe and its adnexa. From 0.5 to 1 cc., with addition of epinephrine, is used for subconjunctival or subcutaneous injection. He reports that it has not been tried as yet for cataract extraction. No general reactions have been observed.

S. R. GIFFORD.

General Diseases

DISEASE AT ITS ONSET, WITH SPECIAL REFERENCE TO OCULAR MANIFESTATIONS.[1] A. MAITLAND RAMSAY, Brit. M. J. **1:** 841 (May 12) 1934.

The capillaries are distinct from the other blood vessels in that metabolic changes occur through their walls, and their contractility is controlled by both vasomotor and chemical stimuli.

Capillaries from two different sources supply the outer and inner portions of the retina. Toxemia causes a rapid dilatation and increased permeability of the capillaries of the choriocapillaris and of the capillaries of the central retinal artery, so that the transparency of the retina is impaired both by the congestion of the capillaries and by its infiltration with colloidal substances.

This abnormal retinal condition is recognized clinically by a want of translucency in the ophthalmoscopic picture together with a dilatation of the capillaries. In cases showing only these two signs the symptoms include neuralgic pains, lights before the eyes, occasional obscurations and some difficulty in matching colors (especially the blues).

The ocular observations are often an indication that there are similar capillary changes in the kidneys, brain, heart and/or other organs. Hence, by means of the ophthalmoscope, it is sometimes possible to recognize disease in its earliest stage at a time when it is probably easily curable.

WALTER F. DUGGAN.

LATENT SYPHILIS AND POSTOPERATIVE OCULAR COMPLICATIONS. B. ADAMIANTIADIS, Arch. d'opht. **50:** 826 (Dec.) 1933.

Some observations are cited here which support the belief that an operation on the eye plays a part in the outbreak of a complication due to latent syphilis, such as interstitial keratitis and iridocyclitis. Adamiantiadis gives brief accounts of five cases in which complications arose following cataract extractions, and were cured by antisyphilitic treatment. Reference is made to the reports of Morax, Elschnig and Puscariu. The latter believes that 60 per cent of the postoperative cases of iritis are due to syphilis. He also refers to two other cases already reported, one of trachoma in which peritomy was done on both eyes, and one in which an optical iridectomy had been done. As a result of the study of these he believes that such cases have characteristic features which should suggest an accurate diagnosis. The first is the late appearance of the complication. It seldom appears within a period of from ten to twelve days, more often later. Iritis which is due either to inclusion of the iris or lens capsule in the wound or to infection has its onset in from three to seven days. A second diagnostic sign is the freedom from pain and from other subjective symptoms. While a positive Wassermann reaction clinches the diagnosis he has found improvement to occur under antisyphilitic treatment when it was negative. The practical conclusion which he points out is that when a late postoperative iridocyclitis occurs latent syphilis should be suspected and active treatment instituted.

S. B. MARLOW.

General Pathology

NEW-FORMED TISSUE IN THE ANTERIOR CHAMBER RESEMBLING STROMA OF THE CORNEA. F. VON PAPOLCZY, Arch. f. Ophth. **131:** 439 (Dec.) 1933.

Von Papolczy describes the pathologic observations in two similar cases of traumatic uveitis. In both of them a new-formed tissue was present in the anterior chamber which resembled corneal stroma very closely. It consisted of lamellae parallel to those of the cornea, took stains just like the corneal stroma and also showed flat cell bodies like the fixed cells of the cornea. In one case this tissue filled most of the anterior chamber; in the other, only one sector of the angle of the chamber. Descemet's membrane showed only one very small defect in the first case and was intact in the second. Von Papolczy believes that the corneal endothelium plays an important rôle in the formation of the aforementioned tissues. To explain the lamellar structure, the action of the same mechanical forces which determine the regeneration of the cornea after inflammatory lesions has to be assumed.

P. C. KRONFELD.

Glaucoma

POSTOPERATIVE INFECTION SEVEN MONTHS AFTER AN ELLIOT TREPHINING IN A PATIENT SUFFERING FROM BILATERAL CHRONIC GLAUCOMA. S. ALEXIADES, Arch. d'opht. **50:** 833 (Dec.) 1933.

Alexiades gives a detailed account of a case that came under his observation in which the right eye was blind and the left presented a high intra-ocular tension, cupping of the disk and nasal constriction of the field, although central vision was normal. After a period of observation a trephining was done on the left eye with good effect and without any complications. The patient was observed regularly twice a month for seven months and showed no symptoms; he apparently was getting along well. Just at the time when the patient was readmitted to the hospital for a trephining on the right eye signs of inflammation appeared in the left which resulted in a total loss of that eye. This was diagnosed as suppurative choroiditis because of the absence of all evidence of inflammation in the anterior segment, the trephine opening being entirely clear throughout the course of the process. General examination of the patient revealed no possible etiologic factor with the exception that two months before she had had an attack of grip. She had been well in the interval, however.

The author entertains the opinion that this was an endogenous infection. He suggests that the filtration through the trephine with consequent alteration of the circulation in the eye produced a locus minoris resistentiae. It is significant that the eye not operated on was not affected.

S. B. MARLOW.

THE EFFECT OF UNILATERAL OPERATION ON THE TENSION OF THE FELLOW EYE. B. G. TOWBIN, B. W. PROTOPOWOW and W. S. URNISHEWSKAJA, Arch. f. Ophth. **131:** 554 (Feb.) 1934.

In a large number of patients subjected to operation on one eye for various conditions of the eye the tension of the other eye was taken twice daily as well as immediately before and after the operation.

In many instances the operation had a more or less definite influence on the tension of the other eye. This phenomenon, which is well known in animals after artificial shock to one eye, seemed to occur more regularly and to a more severe degree in primary glaucoma. In some cases the effect on the fellow eye was beneficial (decrease in tension, improvement of vision); in others it was detrimental. The latter possibility has to be considered very seriously, especially if the possible gain for the eye operated on is questionable. Therefore Towbin "protests against any kind of experiment on an eye affected with glaucoma absolutum."

P. C. KRONFELD.

Lacrimal Apparatus

RELATION BETWEEN DACRYOCYSTITIS AND SINUS DISEASE. C. CODERO, Riv. oto-neuro-oftal. **9:** 60 (Jan.-Feb.) 1934.

Seventy-eight cases of dacryocystitis were studied according to a definite plan of investigation, from which the following conclusions are drawn regarding etiology:

Frequent coexistence of inflammatory processes involving the lacrimal sac and paranasal sinuses is undeniable. Such was the case in 79 per cent of the patients; in 46 per cent it was certain, while in 33 per cent there was a strong probability. In general the sinuses were affected by a simple inflammatory process, more or less accentuated. Only rarely was free pus found in the nose, a sign of inflammation in a strict sense. The sinuses most often affected were the ethmoid, either separately (22 per cent) or together with the other periorbital cavities (51 per cent). Where there was an associated polysinusitis, combinations of ethmoid-maxillary and ethmoid-sphenoid infection occurred. These were observed in 21 per cent of the cases of associated sinusitis.

Twenty-five cases carefully followed up seemed to show that acute or chronic dacryocystitis is quite often followed or accompanied by sinus disease. The author formulates the latter proposition merely as a hypothesis. In fact, in 80 per cent of these, after extirpation of the sac, the sinuses became markedly or completely clear in roentgenograms.

In acute or phlegmonous dacryocystitis sinus involvement is more frequent than in the chronic forms.

V. R. SYRACUSE.

Lens

SPECTROGRAPHIC RESEARCHES ON THE CRYSTALLINE LENS. LO CASCIO and BERTUZZO, Ann. di ottal. **61:** 721 (Oct.) 1933.

Previous work on the subject, most of which was done with instruments of limited scope, is reviewed. The authors employed the large quartz spectrograph of Hilger for determining the transmission of light of various wavelengths through the lens. They found the lens to be more transparent than had been supposed by previous workers. Thus the rabbit's lens transmitted rays down to 3,467 angstrom units, that of the dog to 3,250, the cat's lens to 3,162 and the civet's lens to 3,085. The difference between these figures and that of 4,000 angstrom units reached by Schanz and Stockhausen is explained by the greater accuracy of the Hilger instrument. The greater transparency of the lens

in the cat and the civet seems related to their nocturnal habits. Study of the visibility of the colored spectrum was carried out on forty-six normal subjects with the Zeiss spectroscope graduated from 3,500 to 8,500 angstrom units. The subjects were dark-adapted for twenty minutes. The limits for violet obtained were from 3,905 to 3,715 angstrom units. All subjects except one were below the age of 36, presumably with clear lenses.

S. R. GIFFORD.

BONE FORMATION IN THE LENS. D. MICHAIL, Arch. f. Ophth. **131:** 390 (Dec.) 1933.

A girl, 3 years of age, acquired, immediately after scarlet fever, a corneal ulcer which perforated. Iris and lens healed into the corneal scar. At the age of 19 the patient had the eye removed because of frequent recurrences of iridocyclitis. Pathologic examination of the enucleated eye revealed severe atrophy and partial hyalinization of the uvea. The anterior part of the lens consisted of a solid plate of bone, while the posterior portion showed a more cancellous bony structure. Behind the lens lay the usual cyclitic callus, from which the osseous tissue in the lens received some small arteries. The retina was completely detached, very atrophic and contained deposits of lime salts.

P. C. KRONFELD.

FIVE CASES OF ANTERIOR POLAR CATARACT REPRESENTING A SPECIAL FORM OF BEGINNING SENILE CATARACT. HANDMANN, Klin. Monatsbl. f. Augenh. **91:** 488 (Oct.) 1933.

Handmann reports five cases of anterior polar cataract which resemble the case of dystrophia epithelialis lentis adiposa described by A. von Szily (*Klin Monatsbl f. Augenh.* **90:** 607 [May] 1933; abstr., ARCH. OPHTH. **12:** 267 [Aug.] 1934). In each case the opacity in the anterior pole of the lens developed spontaneously after the fiftieth year of life and was unilateral. The case observed by von Szily, in which both eyes were affected, constituted a more advanced stage, according to Handmann's interpretation. The nystagmus that usually accompanies anterior polar cataract in early childhood was absent in these five cases. The condition represents a special type of beginning senile cataract, against the formation of which no layer of the lens is protected.

K. L. STOLL.

SOME CASES OF ECTOPIA OF THE LENS WITH SPECIAL CONSIDERATION OF THE CONSTITUTIONAL FEATURES. O. KURZ, Klin. Monatsbl. f. Augenh. **92:** 193 (Feb.) 1934.

Five cases of decided congenital ectopia of the lens are reported, and two cases are added in which sagittal displacement of the lens was observed. Three of the five cases of the first category presented Marfan's type with the symptom complex of arachnodactylia.

CASE 1.—A woman, aged 25, had myopia of 20 and 24 diopters respectively. The lenses were clear and were displaced upward and nasalward; a small hernia of the vitreous was presented. The lenses were found to be of normal size and weight after extraction.

CASE 2.—A child, aged 2½, had myopia of 20 diopters and gibbus.

CASE 3.—A woman, aged 44, had abnormalities of the skeleton, small pupillary distance, ptosis and the position of the palpebral fissure described by Rietschel: The temporal canthus was lower than the nasal.

CASE 4.—A man, aged 35, had "moving pupils." Several members of his family had the same condition, and another member had paranoia. He presented chiromegaly, syringomyelia, scoliosis and Dupuytren's contraction, aside from the ocular symptoms. This man's mother, aged 65, had had tuberculosis of the bones of her hands in infancy, kyphoscoliosis, anomalies of the sensory nerves and ectopia of the lens, apparently congenital.

CASE 5.—A woman, aged 22, had unilateral ectopia of the lens in an eye with congenital megalocornea or abortive hydrophthalmos. Atrophy of the iris and other anomalies were present.

CASES 6 AND 7.—A sister and brother presented symmetrical ocular anomalies. Their corneas were slightly enlarged; the anterior chambers were deep; the irides were atrophic; iridodonesis and tremulousness of the lenses were observed. In closing Kurz discusses the question whether the condition in these two cases should be classed with the complex of symptoms of ectopia of the lens or with that of megalocornea; he decided in favor of the latter.

K. L. STOLL.

Lids

INFLAMMATORY ECTROPION AND ITS TREATMENT BY COMPLETE TARSOCONJUNCTIVAL EXCISION. J. FRANÇOIS, Arch. d'opht. **50:** 818 (Dec.) 1933.

François suggests that to the usual four types of ectropion—cicatricial, paralytic, spasmodic and senile—a fifth, inflammatory, should be added. He discusses the probable cause of this type, which in the last analysis is due to thickening of the tarsoconjunctiva secondary to inflammation of the tarsal conjunctiva of the lower lid. He briefly refers to the various therapeutic procedures used, including not only chemical and thermal cauterization but also the plastic operations on the lids proposed by various writers. The procedure advocated by François is an old one, having been employed by Greek, Roman, Arabian and medieval surgeons with good results. It consists of the excision of the swollen exposed conjunctiva and the underlying tarsus. No sutures are used. It is a relatively simple procedure and has given excellent results.

S. B. MARLOW.

IMPROVED ANESTHESIA FOR OPERATIONS ON CHALAZIONS. A. FUCHS, Klin. Monatsbl. f. Augenh. **92:** 190 (Feb.) 1934.

Fuchs describes a new method of anesthetization for operations on chalazions, based on anatomic research of the innervation of the eyelids by O. Novotny (*Klin. Monatsbl. f. Augenh:* **92:** 186 [Feb.] 1934; abstr., this issue, page 955).

After instillation of a drop of cocaine into the conjunctival sac, 0.5 cc. of a 4 per cent solution of procaine hydrochloride is injected into the fornix toward the margin of the tarsus near the chalazion. Thus the nerves on both sides of the tarsus will be anesthetized. Anes-

thesia is complete after four or five minutes. A chalazion located in the extreme nasal portion of the lower lid may form an exception, as anesthesia in such cases may not include the overlying epidermis by reason of the fact that this portion of the epidermis is provided by the infratrochlear nerve, springing from the first branch of the trigeminus, while Fuchs' method blocks the infra-orbital nerve, arising from the second branch of the trigeminus. A second small subcutaneous injection will complete the anesthesia in such cases.

A lid clamp, bearing three teeth on both sides of the ring, measuring 1 mm., and fitting into small grooves in the plate of the clamp, has been devised by Fuchs to prevent slipping. K. L. STOLL.

Methods of Examination

TONOMETRY IN PERNICIOUS ANEMIA. G. F. SUKER, Am. J. Ophth. **17:** 125 (Feb.) 1934.

After a study of thirty-one cases of anemia and leukemia, twenty-five of which were cases of pernicious anemia, Suker states the following conclusions:

1. The intra-ocular tension is markedly lowered in nearly every primary anemia, but particularly in the agranulocytic and pernicious anemias. Apparently in the aplastic anemia and leukemia the intra-ocular tension is also reduced.

2. Only with the return of a nearly normal or definitely improved blood picture does the intra-ocular tension return to nearly normal or normal.

3. The decreased intra-ocular tension in the anemias seemingly does not predispose the eye to any intra-ocular complications, though the anemia may be severe or of long duration.

4. Prolonged decreased intra-ocular tension does not in itself cause marked functional complications.

5. If any ocular lesion accompanies the anemia it assumes greater seriousness and proves rather obstinate.

6. The decrease in the intra-ocular tension seems to bear a closer relationship to the percentage of hemoglobin and the red blood corpuscle count than to the color index and the white blood corpuscle count.

7. A marked drop in the percentage of hemoglobin and in the number of red blood corpuscles and white blood corpuscles is accompanied by a drop in the intra-ocular tension.

8. A rise in these hemal constituents is accompanied by a rise in tension. Not infrequently a reverse occurs.

9. A variation in the blood picture during the course of the anemia is likely to be accompanied by a variation in the intra-ocular tension.

10. In no case was hyperpiesis associated with the anemia.

11. No intra-ocular lesion was engendered during the course of the anemia.

12. No marked alteration of a vessel in the fundus was noticed in any case.

13. In all cases the fundus had a more or less waxy hue.

W. S. REESE.

Ocular Muscles

THE ORTHOPTIC TREATMENT OF SQUINT. MONTAGUE L. HINE, Brit. M. J. **1**: 329 (Feb. 24) 1934.

Hine uses orthoptic treatment for children between the ages of 3 and 7, who have good fixation and a corrected vision of 6/18 or better in the squinting eye. As many squinters seem to obtain simultaneous vision or even fusion while the squinting eye still deviates as much as 10 degrees, Hine prefers a synoptophore for orthoptic training, because with this instrument the trainer can obtain an unimpeded view of the patient's eyes during the training. Convergent squints show the best results. Divergent squints not due to refractive errors are seldom helped. If good binocular vision is obtained but the squint still persists, an operation should be done to approximate the visual axes. Hine thinks that operation under general anesthesia is contraindicated except to prevent development of an inferiority complex in the child or the mother. A statistical analysis of the results of orthoptic treatment is not included in the article.

W. F. DUGGAN.

THE COMBINATION OF FUNCTIONAL, PSYCHOGENIC AND ORGANIC DISTURBANCES OF THE MOTOR APPARATUS OF THE EYES; REPORT OF CASES. A. BIELSCHOWSKY, Klin. Monatsbl. f. Augenh. **92**: 1 (Jan.) 1934.

The question whether ocular paralysis on a basis of hysteria exists remains unsettled. Dividing these complicated cases into three groups, Bielschowsky discusses those which bear the features of a functional neurosis, aside from evident organic symptoms. A number of case histories illustrate the diagnostic and therapeutic difficulties.

CASE 1.—*Paralysis of the Oculomotor Nerve and Hysteria.*—A girl, aged 18, showed a combination of functional, hysterical and anatomic disturbances which were contradictory in the order and etiology of the two components. Sudden ptosis and alleged amblyopia of the left eye had set in four weeks prior to observation. The ptosis was due to a spasm of the orbicular muscle. Pain in the eye followed an attempt to open it, but no pathologic changes existed, except constantly changing crossed double images. The hysterical nature of the ptosis and amblyopia was established, and the diplopia was treated with prisms, the base upward in the right eye, and the base nasal in the left. Their strength could be reduced from 5 to 2 degrees after three days, and the prism glasses were abandoned three weeks after the patient was discharged from the hospital. A preexisting latent disturbance of the muscular balance became manifest after psychical exertion which was followed by fatigue.

CASE 2.—*Horror Fusionis.*—An intelligent and ambitious young man, aged 20, of neuropathic habitus, had had alternating convergent strabismus since early childhood. Three tenotomies of the internal

rectus were done in 1924, 1928 and 1931; the last tenotomy was followed six weeks later by diplopia which forced the patient to bandage one eye lest he should be unable to do his work Vision in each eye was normal. Crossed or homonymous double images of 10 and more degrees existed alternately, although convergence was always manifest, aside from positive vertical aberration, ranging from 2 to 14 degrees, depending on the amount of abduction. Postoperative insufficiency, binocular vision for depth and fusion at a distance were absent. The distance of the double images could be reduced to a minimum by adducing prisms, but they crossed or appeared above one another on the slightest further increase of the prisms. This phenomenon is typical for all cases of horror fusionis. Although the patient begged to have the squint reestablished, so as to be relieved of the double vision, Bielschowsky did not operate again, but resorted to exercises with the amblyoscope and the stereoscope. A favorable result was obtained after five months, proving (1) the correctness of avoiding hasty surgical steps and (2) the curability of horror fusionis by therapeutic means.

He concludes that this especially abnormal case resulted from a congenital defect, namely, a lack of sensory coordination of the eyes. Discussion on this topic is continued in Bielschowsky's article entitled "Exophoria and Excess of Divergence" (*Klin. Monatsbl. f. Augenh.* **92:** 11 [Jan.] 1934).

K. L. STOLL.

Operations

ARTIFICIAL PTOSIS FOR PROTECTION OF THE CORNEA. L. DE BLASCOVICS, Ann. di ottal. **61:** 763 (Oct.) 1933.

This is an Italian version of an article published in the *Zeitschrift für Augenheilkunde* in 1933. The procedure adopted is a resection of the levator through a conjunctival incision, the tarsus being united with the upper edge of the conjunctival incision. The lid is lowered from 6 to 8 mm. immediately, but this effect becomes less, usually from 4 to 5 mm., later. It was employed in cases of lagophthalmos and in one case of exophthalmic goiter. It is much like the procedure described by Goldstein (Recession of the Levator Muscle for Lagophthalmos in Exophthalmic Goiter, ARCH. OPHTH. **11:** 389 [March] 1934).

S. R. GIFFORD.

Orbit, Eyeball and Accessory Sinuses

A CASE OF ACUTE MYCOSIS OF THE ORBIT. P. GEORGARIOU, Arch. d'opht. **51:** 38 (Jan.) 1934.

Tumor of the orbit due to mycosis is very rare. Very often this rarity together with the lack of a previous history make a clinical determination of the etiology difficult. The author gives an account of a case in which an antecedent acute eczematous blepharitis was the only possible portal of entry for the organism. An ulcerative lesion of the skin is the most common point of entry, the respiratory and digestive tracts being two others. All these three possibilities were eliminated in the case observed. The author states that the portal of entry suggested in this case cannot be accepted finally without further control. The blepharitis nevertheless does furnish a valuable etiologic argument on which the present case can be explained.

S. B. MARLOW.

Pharmacology

EFFECT OF INJECTIONS OF ETHYL MORPHINE HYDROCHLORIDE ON INTRA-OCULAR TENSION. A. KRUTOVA, Sovet. vestnik oftal. **3:** 331, 1933.

Twenty-two patients or thirty-one eyes suffering from uveitis, retinal detachment, choroidal and retinal hemorrhages were treated with injections of ethyl morphine hydrochloride (dionin). Three injections of a 5 per cent solution and ten injections of 20 per cent solution were given subconjunctivally into the upper part of the eyeball, i. e., from 0.3 to 0.4 cc., at intervals of from three to four days. A considerable reaction at the site of injection, with pain, chemosis and swelling of the lids, was observed for a few hours. The tension was taken before and at fifteen, thirty and sixty minutes after each injection and daily within the next two weeks. A certain regularity in the change of tension was noticed. Each injection caused an increase of the tension up to from 10 to 15 degrees, which would last a few hours or days and then come down below the initial tension at the end of the treatment. In a few middle-aged patients the increased tension lasted from five to thirteen days. The author therefore advises great caution in the use, in elderly patients, of these injections, as they may cause glaucoma. The change in the ocular tension, Krutova believes, is due to the pharmacologic properties of the preparation. The vision was improved considerably in nearly all cases of vitreous opacities, but the injections produced no effect in retinal detachment or in retinal hemorrhages.

O. SITCHEVSKA.

Physiology

SENSITIVE INNERVATION OF THE EYELIDS. O. NOVOTNY, Klin. Monatsbl. f. Augenh. **92:** 186 (Feb.) 1934.

The sensitive nerves of the eyelids are exclusively provided by the first and second branch of the trigeminus nerve, with anastomoses in the area of the canthi.

After entering the upper lid the first branch is divided into three portions, the nasociliary, supra-orbital and lacrimal nerves. The lateral termination of the nasociliary nerve is the infratrochlear nerve; after perforating the orbital septum it anastomoses with the supratrochlear nerve, a branch of the supra-orbital nerve, and provides the epidermis around the nasal canthus. Another branch of the supra-orbital nerve, the frontal nerve, sends sensory branches into the central third of the upper lid. An interesting variation is a loop, formed by the temporal branch of the lacrimal nerve, originating at the upper portion of the lacrimal gland, and leading behind the tarsus to the temporal canthus.

The infra-orbital nerve provides the lower lid, with two exceptions: (1) a small area of the temporal canthus is provided by the ramus cutaneus malae, or zygomaticofacial nerve, springing from the second branch of the trigeminus; (2) the infratrochlear nerve, springing from the first branch of the trigeminus, extends slightly below the palpebral fissure at the nasal canthus. Fibers of the infra-orbital nerve appear at the lower margin of the orbicular muscle, where they form anastomoses constituting a subcutaneous net, which extends to the

margin of the lower lid. Retrotarsal fibers of the infra-orbital nerve lead into the maxillary periosteum after leaving the infra-orbital foramen and extend into the tarsal conjunctiva.

Four excellent pictures illustrate the ramifications and their course.

K L. STOLL.

VITAMIN C IN THE AQUEOUS AND THE LENS. H. K. MÜLLER, W. BUSCHKE, A. GUREWITSCH and F. BRUHL, Klin. Wchnschr. **13**: 20 (Jan. 6) 1934.

The authors, following the work of H. K. Müller, who showed that vitamin C is found in the aqueous, have investigated further. In animals it was determined that vitamin C is present in the aqueous in a far greater amount than in any other of the body cells or fluids. The lens of cattle has as much as four times the percentage amount of vitamin C as the lens of rabbits. In cattle vitamin C was found in the vitreous, ciliary body, iris, retina and cornea, but in the latter in very minute quantity. In cataractous lenses of animals and man the loss in vitamin C is in direct proportion to the amount of involvement and eventually reaches 100 per cent. Regenerated aqueous following an operative procedure had less vitamin C than the normal aqueous. The entire investigation is an attempt to prevent the formation of cataract through loss of vitamin C. A bibliography is given.

L. L. MAYER.

Refraction and Accommodation

ASTIGMATISM AFTER OPERATION FOR CHALAZION. A. HUDELO, Arch. d'opht. **51**: 33 (Jan.) 1934.

Hudelo describes a case of chalazion in which it was impossible to obtain any anesthesia with procaine hydrochloride. The operation was followed by severe pain which prevented sleep and an astigmatism of 1 diopter which lasted six days and disappeared on the seventh. The ophthalmometer demonstrated this astigmatism to be corneal. He does not think that the action of the extrinsic muscles or the pressure of the lids played any part in its production. He suggests that it was due to loss of pressure of the lids. This he explains as the result of a "toxic paralysis based upon inhibition of the sympathetic." The observations which support this idea are the extreme difficulty of obtaining anesthesia, the severe pain after operation, and the onset of an astigmatism within a few hours which lasted six days. These are divided into three phases: (1) pain, (2) atony, (3) recovery. The case is of interest from two points of view: (1) the occurrence of an unusual postoperative discomfort and visual failure; (2) the inability to obtain anesthesia with procaine hydrochloride, the pharmacologic action of which affected the sympathetic.

S. B. MARLOW.

Retina and Optic Nerve

THE EVOLUTION OF IDEAS CONCERNING RETINAL DETACHMENT WITHIN THE LAST FIVE YEARS. J. GONIN, Brit. J. Ophth. **17**: 726 (Dec.) 1933.

This is the William MacKenzie Memorial Lecture, 1933.

In order to get a general view of the evolution of ideas concerning retinal detachment within the last five years, five points are considered: 1. The frequency of holes or tears detected in the detached retina

(speaking only of so-called idiopathic or spontaneous detachment). 2. The importance of holes or tears in the beginning and in the extension of the detachment. 3. The cause and mechanism of the formation of holes. 4. The conditions of successful treatment. 5. The best way to fulfil these conditions.

Regarding the first point, Gonin refers to the growing acknowledgment of the frequency of tears and quotes Arruga, who claimed that he saw them in 90 per cent of the cases which he had recently observed. This high proportion is the more remarkable because of the many circumstances which might make a tear unnoticeable. Some tears are so large as to be misleading, the part of the choroid deprived of retina being mistaken for healthy on account of its seemingly normal red appearance. More often a hole will escape notice because it is too peripheral or too small or is concealed behind the lens or behind opacities of the vitreous.

Summarizing the pathology of retinal detachment, as confirmed by the many observations made during the past few years, it may be said that the presence of a hole or of several holes is a necessary condition in any loose detachment, but that it is not the only one: previous or subsequent alterations of the vitreous body allow these holes to become the starting point of a progressive detachment. The truth is that holes or tears are a condition of any loose detachment and that in most cases previous changes in the vitreous have taken part in their formation.

Gonin keeps an open mind regarding the more recent procedures to secure reattachment of the retina but warns against the danger of the belief of some physicians that they may refrain from carefully looking for and locating tears.

W. ZENTMAYER.

HEMORRHAGIC NEURORETINITIS OF DENTAL ORIGIN. L. WEEKERS and R. RUBIN, Arch. d'opht. **50:** 751 (Nov.) 1933.

In the first part of this paper the authors cite in abstract form the work of Móczár (*Ztschr. f. Stomatol.* **30:** 651, 1932), in which the latter deals with twenty-four deaths due to acute dental infection, with autopsy in twenty-two. Among the twenty-four cases there were ten with a cerebral localization. In seven of these ten there was retro-ocular inflammation. The observations of Schwabe, who had in thirty years seen twenty-one cases of orbital inflammation of dental origin, and the report of Fromaget are also cited. While such acute processes are beyond dispute, the more chronic are still subject to considerable discussion. The great variety of ocular conditions attributed to dental infection and the abundance of theories to explain them are in striking contrast to the scarcity of proved facts. The authors believe nevertheless that progress can be made by the publication of detailed reports of thoroughly investigated clinical observations. With this in mind they report in full a personal observation and cite cases reported by Terson and Michaux (one each) which suggest that there is a special type of hemorrhagic neuroretinitis dependent on dental infection. They cautiously state that these cases are not definitely proved to be of dental type and that the establishment of a type of neuroretinitis due to dental infection will depend on the report of more cases of a similar nature.

S. B. MARLOW.

THE VASOMOTOR REACTION OF THE RETINA IN EXPERIMENTAL HYPERTENSION. L. WEEKS and L. DAUTREBANDE, Arch. d'opht. **50**: 786 (Dec.) 1933.

The authors have studied the retinal vasomotor reactions in dogs during an acute hypertension produced by sudden hypotension in the carotid sinus. The rôle played by variations in the intrasinus pressure in the regulation of the general vasomotor tone has been known since Hering noted this. Hypertension in this area produces somatic hypotension with bradycardia, whereas intracarotid hypotension leads to somatic hypertension with vasoconstriction and tachycardia. The authors point out the possible sources of error in experimenting on dogs and the inaccuracies of ophthalmoscopic observation. However, they believe that there is some valuable information to be derived by this method. As a result of their experiments on chloralized dogs they conclude (1) that acute hypertension produced by hypotension in the carotid sinus is accompanied by changes in the retinal circulation, (2) that these circulatory changes are not due to ischemia but are produced by a reflex mechanism whose origin must be in the carotid sinus and whose centrifugal arc passes through the cervical sympathetic, (3) that these changes are characterized in the majority of cases by a vasoconstriction which comes on at the height of the hypertension, and (4) that unanesthetized dogs made hypertensive by section of both the nerves of Hering and Cyon present the same retinal vascular changes that are seen clinically in patients with hypertension.

S. B. MARLOW.

RESULTS OF TREATMENT OF DETACHMENT OF THE RETINA BY DIATHERMY. P. JEANDELIZE and R. BANDOT, Arch. d'opht. **50**: 793 (Dec.) 1933.

The authors classify the various technics for the use of diathermy in detachment of the retina into four groups. The first group includes those that act on the surface of the sclera as proposed by Weve and later by Weekers. The second group includes the use of penetrating needles as suggested by Weve. The third group is composed of those in which the sclera is penetrated without injuring the retina according to Weve, Šáfár or Lindner. In the fourth class is the method of Genet, in which the sclera is penetrated but by means of an enameled protection action is confined to the pocket of the detachment. The authors have employed Šáfár's method as modified by Lindner in sixteen cases. In four of these the detachments were characterized by enormous tears and Gonin's method was rejected. They were also unfavorable for diathermy not only for this reason but also because they were old. They are omitted from the statistics. In nine of the remaining twelve cases there was a tear or a disinsertion and in three none which could be discovered. In eight of the nine with tears the retina became reattached. In the unsuccessful case there were two tears quite far apart. In one of the three cases without tears there was an extensive vitreous opacity, in one a cataract extraction and in one an old long-standing detachment. In the first and third of these the retina became reattached. The authors describe an additional case with one tear nasally and a second in the macular region. In this case treatment was unsuccessful.

Although the cases are too few to make a statistical report, the authors state that in their experience no other method has given them such good results. They believe diathermy to be the best operative treatment for sealing the tears in the retina. S. B. MARLOW.

STUDY OF PATIENTS WITH RETINAL DETACHMENT IN THE SECOND EYE CLINIC AT VIENNA WHO WERE OPERATED ON AFTER GONIN OR GUIST DURING 1929, 1930 AND 1931 AND DISCHARGED UNIMPROVED. H. RIEGER, Arch. f. Ophth. **131:** 410 (Dec.) 1933.

Rieger has conducted the follow-up work on the patients with retinal detachment who were operated on at the Lindner Clinic in Vienna and later on discharged with the remark that the detachment was not healed. The operative procedures used during the period from 1929 until 1931 were ignipuncture after Gonin and multiple trephinings plus cauterization with potassium hydroxide after Guist. The follow-up work revealed the interesting fact that in about 20 per cent of the patients the retina became reattached after the discharge from the hospital. This occurred with the same frequency after the Gonin as after the Guist procedure. Twenty-five per cent of all the patients discharged as not improved became blind. This also occurred with the same relative frequency after each operative method. The vision was, on the whole, comparatively better after the Guist operation than after the ignipuncture. Total complicated cataract developed in 42 per cent of the eyes treated by ignipuncture and in 27 per cent of those treated by multiple trephine operations; 17.6 per cent of all the eyes under study became atrophic after the Guist operation and 11.1 per cent after the Gonin procedure. Not a single patient showed signs of sympathetic ophthalmia.

From these results Rieger draws conclusions concerning the prognosis in retinal detachment. Old age of the patient, long duration and large extent of the detachment, multiplicity as well as large size of the tears, invisibility of the tears and lack of cooperation on the part of the patient make the prognosis unfavorable. Other things being equal, traumatic detachments and those occurring in aphakic eyes are less amenable to treatment than those developing in myopic eyes. The myopic degeneration of the vitreous relieves the retina of all inward traction, which the normal vitreous so often exerts.

P. C. KRONFELD.

THE RETINAL VESSELS IN HYPERTENSION. L. SALLMANN and H. KAHLER, Arch. f. Ophth. **131:** 505 (Dec.) 1933.

Sallmann and Kahler have been studying cases of hypertension and arteriosclerosis from the medical and ophthalmoscopic point of view for several years. Kahler has introduced a new classification of hypertension, based on the neurologic mechanisms of this condition. The main differentiation is made between central and peripheral hypertension. In the former the cerebral vasomotor center is in a state of abnormal function; in the latter the neuromuscular apparatus in the arteries is primarily affected. In 1925 (*Ztschr. f. Augenh.* **57:** 386, 1925) Kahler and Sallmann published the results of their first conjoint studies. They

concluded that narrowing and straightening of the arteries, which are accompanied by bright, cleancut reflexes, are the most important ophthalmoscopic signs of hypertension.

Since 1925 three other ophthalmoscopic phenomena have received considerable attention in connection with hypertension, namely Gunn's nicking of veins, its higher degrees as described by Salus and Guist's tortuosity of the macular veins. Sallmann and Kahler have studied their material with special attention to these signs, and have found that the nicking of the veins and its higher degrees indicate arteriosclerosis. These phenomena are therefore frequently seen in hypertension of central origin, but also in arteriosclerosis without hypertension. The tortuosity of the macular veins is commonly found in patients with hypertension, but also in patients with cardiovascular diseases without hypertension. The authors are inclined to see in the tortuosity of the macular venules a sign of a congenital anomaly of the vascular system.

Focal ophthalmoscopy is, in the opinion of the authors, the best method for detecting the earliest signs of retinal arteriosclerosis, namely partial loss of translucency of the wall of the vessel. That occurs most frequently in hypertension of central nontoxic origin and indicates sclerosis of the cerebral vessels. P. C. KRONFELD.

SO-CALLED CENTRAL RETINITIS. S. KITAHARA, Acta soc. ophth. jap. **38:** 1 (Jan.) 1934.

Kitahara has examined 394 cases of central chorioretinitis at the ophthalmologic clinic of Keio University during the past ten years. The condition can be subdivided into four groups: (1) serous central chorioretinitis (Masuda), (2) solitary tubercle of the choroid in the macular region, (3) syphilitic central chorioretinitis and (4) other forms.

In recent cases of serous central chorioretinitis a subcutaneous injection of old tuberculin was tried, and in nine of the cases a positive reaction was observed. The author does not accept Asayama's view that the disease is the result of the action of light, particularly when combined with photodynamic substances (Oguchi and Ko), nor does he think syphilis is the cause for the disease. By reason of the similarity of the condition in most cases to the solitary tubercle of the choroid, he believes that it is a tuberculous process, particularly if other causes seem to be ruled out. This view is further supported by the fact that injection of tuberculin may not produce a focal reaction although a tuberculous origin is likely. A. KNAPP.

Trachoma

THE HISTOLOGIC FINDINGS IN EARLY CASES OF TRACHOMA AND OF FOLLICULAR CONJUNCTIVITIS. J. TABORISKY, Arch. f. Ophth. **131:** 174 (Nov.) 1933.

Taborisky is well known for his previous papers on trachoma in Palestine. The object of this paper is to describe the pathologic features of trachoma from its earliest stages up to that of one year or more. A special effort is made throughout the paper to find relations between certain pathologic pictures and certain periods of duration. The pathologic material consisted of conjunctival smears and excised pieces of

conjunctiva taken from the lower or upper fornix in sixty-three cases. The earliest case was one of three days' duration. In this case the clinical picture of the eye was, of course, not yet characteristic of trachoma, but the appearance of its mate permitted at that time the diagnosis of trachoma with certainty. The situation in most of the other very early cases is similar. In all, later on, the classic picture of trachoma developed. These studies revealed the fact that the picture of the normal conjunctiva is not uniform in Palestine. Patients who have not been in Palestine very long have an epithelial lining of the conjunctiva fornicis which consists of two or three layers only. The superficial layer carries cylindric, the deeper layer cubical, cells. The subepithelial fibrous stratum is rather thick and formed by delicate, loose connective tissue. In the deeper layers the fibers lie parallel to the surface, and the bundles become denser and coarser. There really is no adenoid layer.

In the native Palestinians the epithelium of the fornices carries from four to six layers; the middle layers are polyhedral, and the cells are connected with each other by intercellular processes. The superficial fibrous layer is narrow, and the fibers are coarse. Taborisky believes that this type of conjunctiva is already pathologic and represents the after-effect of repeated attacks of severe conjunctivitis of any cause.

Trachoma produces most of its characteristic pathologic changes during the first week of its existence. The epithelium is transformed into flat cells and begins to proliferate and to invade the deeper layers. The tunica propria is diffusely infiltrated, and lymphocytes begin to accumulate in places. All elements of the conjunctiva take part in a general hyperplastic process. The endothelial cells of the lymph vessels also proliferate and form the so-called lymph-epitheloid cells which are gradually transformed into lymphoblasts and mature lymphocytes. These types of cells with a few intermediate forms make up the primary follicle. Furthermore, all the other signs of inflammation are present, more or less pronounced.

After the first week the further course of trachoma varies greatly. The intensity of the disease seems to be the determining factor. In some cases the epithelium shows a prevailing degeneration; in others, hyperplasia; in the subepithelial tissue hyperplasia and infiltration increase; in certain cases, one more than the other. During the second month the clinical picture usually develops clearly into either the follicular, the diffuse or the papillary trachoma. The histologic picture shows many more varieties than the clinical. Taborisky refrains from statements in regard to the pathogenesis of the trachomatous scar because of the inadequacy of his material. He, however, does not regard Birch-Hirschfeld's studies as conclusive proof of the correctness of the latter's view that death of cells which immigrate into tissue clefts and multiply by direct division antecedes the formation of scars.

He also describes his histologic observations in sixteen cases of folliculosis and follicular conjunctivitis. Here, transformation of the normal epithelium into flat pavement cells is very rare. Usually, the cylindric shape of the superficial layer is well preserved. The subepithelial layer never shows as much infiltration as it does in trachoma. Occasionally it remains normal except in the immediate vicinity of the follicles. "In trachoma subepithelial infiltration is the primary change

and the follicle only a secondary feature, while in follicular conjunctivitis the opposite situation prevails." In only one case can the pathologic differentiation between trachoma and follicular conjunctivitis be difficult, namely, that of recovery from a trachoma which has not led to scar formation. Healed trachoma frequently has an inclination toward folliculosis. If no scars can be found clinically in such cases, the apparently absurd situation may arise that some members of one family have definite trachoma, while in others the conjunctiva gives the typical picture of follicular conjunctivitis. The correct diagnosis in cases of the latter type, based on observation of the earlier stages, is: trachoma in the state of recovery. Taborisky believes that the condition of the epithelium, which can be studied easily in epithelial smears, is the most valuable differential diagnostic sign.

These very comprehensive studies indicate again that trachoma is an inflammatory and not only a hyperplastic disease. The follicle, however, during its development, follows very closely the cytologic stages which lymph glands go through during their regeneration. The function of the follicle is the formation of lymphocytes. The latter is apparently one form of local response to the infectious agent. In folliculosis the infectious agent has no general toxic effect. Follicles are formed only where the virus has entered the tissue. Taborisky does not agree with Christeller who interprets the hyperplasia of lymphatic tissue as a tissue reaction which is somewhat related to inflammation but follows and outlasts it. In experimental transfers of follicular conjunctivitis follicles can be made out on the third day following the infection. It may take two months for those follicles to reach cytologic maturity. If the stimulus does not last that long, follicles may be absorbed before they have reached maturity. According to Taborisky, the follicle is only a relatively specific tissue reaction.

P. C. KRONFELD.

Tumors

SARCOMA OF THE CHOROID IN A SHRUNKEN GLOBE EXHIBITING FIBROUS FORMATION ABOUT THE TUMOR. B. CHANCE, Am. J. Ophth. **17**: 48 (Jan.) 1934.

Chance reports the case of a woman, aged 50, who consulted him first in May 1925 because of pain in the left eye. Three years previously she was struck on the left side of the head and a few days later the eye became red and inflamed. Examination revealed a much shrunken globe the cornea of which was blood-stained, and there was a stratified hyphemia, the top layer being fresh. The iris was atrophic, the lens calcareous, and the eye exceedingly tender. Enucleation was finally consented to because of the pain. On Jan. 31, 1928, the patient died of malignant disease of the abdomen. Permission to perform an autopsy was not obtained. Examination of the enucleated eye disclosed a sarcoma composed of spindle-shaped and small round cells. There were signs of exudation in the choroid, from which the fibrous tissue described by Collins was seen to have originated and extended, finally surrounding the tumor. The author comments on his case in relation to others reported.

W. S. REESE.

TRAUMATIC CYSTS OF THE IRIS. P. BONNET and L. PAUFIQUE, Arch. d'opht. **51:** 5 (Jan.) 1934.

The two cases, fully described, with illustrations, are examples of pearl cyst and transparent cyst. The cases are of special interest from the point of view of operative treatment and the difficulties involved. The interest in the first case lies in the secondary graft in the iris by implantation of a fragment of the cyst. Moreover, the cilium present was not involved in the cyst, but the authors feel nevertheless that the development of a pearl cyst is favored by the presence of a cilium in the anterior chamber. The second case is representative of the classic transparent epithelial cyst. The indication for operation in this case was based on the belief that the accompanying cyclitis with hypertension was due to the presence of the cyst. The result confirmed this belief. This case further illustrated the difficulties which may be encountered during operation. S. B. MARLOW.

A SINGULAR LESION OF THE BULBAR CONJUNCTIVA FOLLOWED BY A NEVO-EPITHELIOMA. E. KALT, Bull. Soc. d'opht. de Paris, January 1934, p. 36.

An Algerian showed the following: a loss of substance from the temporal bulbar conjunctiva, measuring 6 mm. horizontally, bordering on the cornea but not affecting it. The lesion was of six weeks' duration and had had a spontaneous origin without any special ocular reaction. Recovery took place after five injections of mercuric cyanide. Kalt is inclined to believe that the lesion may have been syphilitic. When correcting the proofs for this article Kalt was informed that the patient had appeared at the Rothschild Foundation with a tumor of the lower culdesac which proved to be a nevo-epithelioma. The article is illustrated with a photograph and includes a discussion of the condition. L. L. MAYER.

MIXED TUMOR OF THE ORBIT. CARLOS S. DAMEL, Arch. de oftal. de Buenos Aires **8:** 187 (May) 1933.

This is a clinical and pathologic report of a case of mixed epithelial and connective tissue tumor of the orbit. The tumor was encapsulated; it was of a myxoid nature with fibroid formation in the periphery and connective tissue bands crossing the tumor mass in different directions; the epithelial tissue occurred in the form of cell nests and cylindric formations. Damel reviews the literature and inclines to the view that tumors of this class originate in the lacrimal gland. C. E. FINLAY.

Uvea

"INFLAMMATIONS" OF THE IRIS AND THEIR CARE. L. HEINE, Deutsche med. Wchnschr. **60:** 16 (Jan. 5) 1934.

Heine reports in brief 20 cases of diseases of the iris, in none of which an absolute etiologic factor could be substantiated. In addition, he gives statistics concerning such lesions as found in his private practice. Of 308 patients, 21 had bilateral blindness; 21 had monocular

blindness; 19 had a great degree of bilateral visual loss; 54 had a great degree of visual diminution in one eye; 173 had little or no loss of vision, and 20 of those with slight loss had unilateral impairment.

Of 363 patients with unilateral or bilateral iritis, only 210 are alive. Of 95 of the patients under 50 years of age, 12 are living; of 129 between the ages of 50 and 70, 95 are living, and of 44 over 70 years of age, 24 are living.

Heine recommends foreign protein therapy (milk). Iridectomy is his choice of operative procedures. Each of the 20 cases is considered briefly and its description is illustrated by a colored picture of the iris. A short bibliography is appended. L. L. MAYER.

Vision

THE INFLUENCE OF ILLUMINATION ON THE VISUAL ACUITY FOR WHITE OBJECTS ON A BLACK BACKGROUND. S. W. KRAVKOV, Arch. f. Ophth. **131**: 452 (Dec.) 1933.

The dependence of visual acuity on illumination is a simple logarithmic relation if black targets on a white background are used. In the case of white targets seen against a black background the relation is more complicated. At first the visual acuity increases rapidly with increasing intensity of illumination until a definite maximum is reached, wherefrom the visual acuity decreases again. Wilcox explains this phenomenon as an effect of irradiation. In experiments of Kravkov and Biletzky, however, the effect of irradiation was found to increase with increasing intensity of light. Kravkov therefore believes that a second factor, namely, difference in sensitivity, plays a part in the peculiar behavior of the visual acuity for white targets. The dependence of difference in sensitivity on intensity of light was recently studied by Houston. If the curves illustrating the relation between irradiation and illumination and the relation between difference in sensitivity and illumination are combined by multiplying the values of irradiation with the corresponding differences in sensitivity, a new curve results which resembles very closely the behavior of the visual acuity for white objects under the influence of varying intensities of light. P. C. KRONFELD.

Vitreous

THE AFFINITY OF THE VITREOUS BODY TO DILUTE PLASMA GELS. STEWARD DUKE-ELDER and E. B. ROBERTSON, Brit. J. Ophth. **18**: 251 (May) 1934.

Reference is made to the conclusion of Duke-Elder that the vitreous body is a gel made up on the basis of specific protein constituents to which is physically absorbed quite an unusual quantity of watery solution (intra-ocular fluid). A further characteristic which seems to place the vitreous gel in a class by itself is the extreme dilution of the gelable constituent (0.025 per cent). To determine whether these properties are unique, observations were made on the behavior of the gel which

results from the dilution of blood plasma to such an extent that the concentration of its protein constituent corresponds to that found in the vitreous body, and the surprising fact became evident that a gel was produced macroscopically identical with and indistinguishable from the vitreous.

W. ZENTMAYER.

THE VISCOUS-ELASTIC PROPERTIES OF THE VITREOUS BODY AND ITS REACTION TO EXTERNAL FORCES. S. DUKE-ELDER and E. B. ROBERTSON, Brit. J. Ophth. **18:** 433 (July) 1934.

A technic has been evolved which appears to meet the very exacting conditions required to obtain measurements of the response of the vitreous body to external forces and of its viscous and elastic properties. It has shown that the vitreous possesses viscous and elastic properties similar to those of gelatin, and of the same nature as those of dilute plasma clots. Acidification causes the gel to behave more like an ordinary elastic solid, increasing the instantaneous displacement and diminishing the "creep." The results indicate that the vitreous humor is a gel composed of a mesh of elastic fibrillae suspended in a viscous liquid, a view which is borne out by ultramicroscopic examination, and which has previously been fully elaborated.

The technic here described could form a method for the exact study of the physical state of the vitreous gel in different pathologic conditions, providing as it does an index of the consistency of the gel and its shrinkage or turgescence owing to the withdrawal or addition of water of absorption to the colloid micelles. It is interesting that the state of a slightly acidified vitreous corresponds to that of an early degeneration and breakdown of the gel structure. Such a condition is seen in many cases of retinal detachment; and in this case the increase of sudden instantaneous displacement on the application of forces and the diminution of the slow "creep" may be of considerable mechanical significance.

W. ZENTMAYER.

THE MICROSCOPIC AND ULTRAMICROSCOPIC STRUCTURE OF THE VITREOUS. F. K. STUDNICKA, Compt. rend. Soc. de biol. **115:** 1557, 1934.

The vitreous is homogeneous to ordinary microscopic inspection, but shows a glossy fibrillar structure with the slit lamp or when examined by ultramicroscopic methods and the use of the immersion dark-ground illuminator. That this structure is not an optical effect is indicated by the following: (*a*) On gently heating the vitreous the fibrillae can be seen to move; (*b*) the structure is rendered visible to the ordinary microscope if the fresh vitreous is previously treated with colloidal silver or dilute Chinese ink, owing to adsorption of the particles, or if certain fixatives are used, such as 0.5 per cent chromic acid or 4 per cent potassium bichromate acting for twenty-four hours.

J. E. LEBENSOHN.

Sympathetic Ophthalmia

SYMPATHETIC OPHTHALMIA IN THE LIGHT OF NEWER EXPERIMENTAL RESULTS. A. JESS, München. med. Wchnschr. **81**: 786 (May 25) 1934.

Jess distinguishes between sympathetic ophthalmia, iridocyclitis and a sympathetic irritation.

The true sympathetic ophthalmia may begin in and usually affects the anterior segment of the globe, but at times the anterior segment is intact and a neuroretinitis or a choroiditis is the first sign. Where pus formation is noted a histologic picture of sympathetic ophthalmia is extremely rare. The various theories as to the mode of transfer to the uninjured eye are discussed. The time element in the production of the reaction in the sympathizing eye is shown to be variable by case reports. The frequency has been reduced to 2.18 per cent by greater care and the use of the slit lamp. The experimental work of Guillery, von Szily and especially that of Meller are cited in detail. Local and general methods of therapy are outlined. Prophylaxis is considered by Jess to be the best preventive for the condition. The rule that every perforated blind eye should be removed is one followed by the best clinical experience. The bibliography is adequate. L. L. MAYER.

Therapeutics

TREATMENT OF MYASTHENIA GRAVIS WITH EPHEDRINE. D. MCALPINE, Lancet **1**: 180 (Jan. 27) 1934.

McAlpine reports on six cases of myasthenia gravis treated with ephedrine. In three there were natural remissions and the part played by ephedrine was therefore impossible to gage. In the remaining three a definite improvement followed. The medicine was administered in the quantity of one-half grain (0.03 Gm.) twice a day. When excessive fatigability formed the only symptom and the use of ephedrine was followed by improvement, the case was considered as possibly one of myasthenia gravis. The author concludes that ephedrine is of definite value in the treatment, though the conditions may progress during its use. On theoretical grounds the action of ephedrine should be reinforced by an amino-acid such as glycine. A. KNAPP.

PHYSIOLOGIC AND THERAPEUTIC ACTION OF COLLOIDAL SOLUTIONS OF PROVITAMIN A IN THEIR LOCAL APPLICATION TO THE EYE. R. A. RATSCHEWSKIJ, Klin. Wchnschr. **13**: 918 (June 23) 1934.

Ratschewskij has prepared a collyrium of provitamin A, carotene ($C_{40}H_{56}$), by extracting with alcohol, ether and acetone this substance from carrots and nettles. By the addition of water this is made into a colloidal solution containing from 8 to 2 mg. of carotene per hundred cubic centimeters. Aqueous solutions have also been used. The color of the solution is influenced by its concentration of carotene. On standing the solution assumes a violet color due to oxidation. Since May 1933 the author has experimented with the solution in 200 cases of disease involving the lids, conjunctivae and corneas.

The following conclusions are reached from this preliminary investigation:

1. The greatest physiologic and therapeutic value of carotene and its oxidation product in superficial lesions of the eye is due to the local application. Chronic conjunctivitis of various causes, scrofulous blepharoconjunctivitis, keratitis, lesions of malarial fever, syphilis and trachoma, and burns due to ultraviolet rays regenerated more quickly and with less severe symptoms when treated with carotene.

2. Because carotene has no bactericidal effect and does not influence the blood vessels there is little value in its use in acute inflammations.

3. The changes due to carotene are the quicker regeneration of epithelium and of the subepithelial layers.

4. The colloidal carotene solution has less power because of its inability to go deep.

5. Further experimentation is necessary before the subject may be placed on a sound basis.

L. L. MAYER.

IONTOPHORESIS IN OPHTHALMOLOGY. A. BIELSKY, Sovet. vestnik oftal. **4: 123, 1934.**

Bielsky presents the results of a thorough study of the contemporary standing of iontophoresis in ophthalmology. He has experimented with it on both animals and patients since 1928, applying various methods and solutions. He discusses in detail the action and the effect of iontophoresis on the tissues and the process of ionization. He and his co-workers established experimentally that the reflectory action of iontophoresis consists in saturating the skin with ions which irritate the skin nerve ending, "the receptors." This irritation is transmitted to the vegetative nervous system, the result of which is the condensatory excitability of the voluntary muscles. If iontophoresis is done on a cocainized skin there will be no effect, which is one of the proofs of this theory. Since the vegetative nervous system most likely regulates all trophic processes in the tissues and in the metabolism of each cell, there is a possibility of increasing or decreasing the vegetative tonus, thereby influencing the physiologic functions and the pathologic deviations in the life of the tissues.

Reflectory zinc iontophoresis was used successfully in corneal scrofulous ulcers due to malnutrition, also in neuroparalytic keratitis. Bielsky experimented on rabbits with preliminary irradiation by the Kromayer lamp, which was followed by potassium iodate iontophoresis. He found that this combined method causes ionization of the atoms of the tissues of the eye, changes the ionic structure and creates favorable conditions for the penetration of ions from the outside world. The irradiation also increases the osmosis.

The combined treatment was applied with favorable results in deep tuberculous and syphilitic keratitis. In numerous cases of corneal ulcerations and infiltrates zinc iontophoresis gave good results, while in corneal opacities iodine and calcium iontophoresis gave better results. The best results, Bielsky believes, he obtained in diseases of the choroid

of myopic origin. For a period of three and a half years one hundred patients with such conditions were treated by the combined method, and absorption of the vitreous opacities, choroidal lesions and hemorrhages into the vitreous was obtained.

In cataracts the routine use of iontophoresis was unsuccessful, but on nine patients calcium iontophoresis was tried locally and reflectory for a period of six months, as the author believes that the calcium metabolism may be regulated through the vegetative nervous system. In retinal detachments no improvement was observed.

Bielsky believes that iontophoresis is a powerful therapeutic agent in numerous diseases of the eye. However, more experimentation and more knowledge of the chemical and biologic processes in the tissues are necessary in order that this remedy may be used properly.

O. SITCHEVSKA.

Toxic Amblyopia

AMAUROSIS FOLLOWING TOPICAL APPLICATION OF ETHYL HYDROCUPREINE IN ACUTE SEPTIC SORE THROAT. E. W. GRIFFEY, South. M. J. **27**: 569 (July) 1934.

Griffey states that those who prescribe ethylhydrocupreine should be familiar with its dangers to the visual pathways. The toxic action is due to a spasm of the retinal vessels causing ischemia of the retina. Degenerative changes occur in the ganglion cell layers of the retina and, if severe, lead to ascending atrophy of the optic nerve fibers. Depending on the severity of the reaction, the final visual results grade from complete recovery, through relative or absolute scotomas and constricted visual fields, to complete and permanent amaurosis. The toxic action of the drug on the visual apparatus may be due to drug idiosyncrasy in a susceptible person or to faulty elimination in one who is nonsusceptible. He reports a case of complete amaurosis in a patient having damaged kidneys who received not more than 8 grains (0.5 Gm.) of the drug by topical application to the pharyngeal mucosa.

J. A. M. A.

A CASE OF GAS POISONING WITH UNUSUAL COMPLICATIONS. H. GRIMSDALE, Brit. J. Ophth. **18**: 443 (Aug.) 1934.

This case report concerns a man aged 32. While working in a sewer he became unconscious and also received a severe burn of the right arm. He remained in a state of coma four days. This was followed by a condition of cerebral irritation. At first there was no control over the excreta, and he could not swallow. Five days after the accident the patient seemed quite blind, although the pupils reacted well to light. The fundi were normal. Bodily reflexes except the abdominal ones were lost. Recovery was slow. Nine months later vision equaled light perception, and colors could be perceived. The fundi remained normal and the optic papillae of good color. Grimsdale attributes the toxemia to illuminating gas but believes that not all the toxic symptoms were due to carbon monoxide.

W. ZENTMAYER.

QUININE AMAUROSIS TREATED WITH ACETYLCHOLINE WITH RECOVERY ESPECIALLY OF THE TEMPORAL FIELDS. E. HARTMANN AND J. VOISIN, Bull. Soc. d'opht. de Paris, February 1934, p. 54.

The blindness of the patient occurred twenty-four hours after the first dose of quinine. Five grams were taken during this period. The visual fields were limited to 15 degrees. Visual acuity equaled 1/20. The pupils were widely dilated and did not react to light. Acetylcholine was given in daily doses of 0.8 Gm. In forty-five minutes after the first dose the vision was recorded as 2/10; in two hours as 5/10. Vision returned to normal in four days. The visual fields showed no recovery except for the horizontal temporal sector of both eyes where it returned as far as 45 degrees. The authors feel that the action produced by the acetylcholine is indicative that quinine amblyopia is of vascular origin. Visual field charts are shown.

L. L. MAYER.

Society Transactions

AMERICAN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY

PARKER HEATH, M.D., *Secretary*

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RETINAL DETACHMENTS: CLINICAL EXPERIENCES WITH DIATHERMIC TREATMENT. DR. MARK J. SCHOENBERG, New York.

This paper will be published in full in a subsequent issue of the ARCHIVES. Since it was discussed with the paper by Dr. Walker the discussion is incorporated in these proceedings following the abstract of the latter paper.

NEW DEVICES AND A MODIFICATION FOR DIATHERMIC OPERATION AND LOCALIZATION IN SEPARATION OF THE RETINA. DR. CLIFFORD B. WALKER, Los Angeles.

Dr. Walker described micropins made of 20 per cent iridium-platinum with small platinum stops for insulation, which are used in multiple micropuncture in the treatment of the separated retina. As the narrow stop or coil of the pin comes down on the sclera according to its contact area, an additional amount of amperage is indicated on the meter; yet this adds not to the dose already on the shaft of the pin inside the eye but to that on the scleral surface, so that a partial beveling of coagulation is formed at the top of the puncture; therefore, it is not necessary to watch the meter continuously. The author has found micropuncture satisfactory in that it does not require insulation of stops, since with single pins the contact area is less than or equal to the surface area of the pin. The actual performance of the micropins is not hidden from view by a relatively large shoulder designed to support insulation. The advantages and disadvantages of insulation were discussed. A method for threading the pins was presented, which permits the individual threads to be eliminated entirely as fast as they are coagulated into the sclera. A forceps that will fit into the handle, instead of the stylus and tweezers for handling the pins, and a ring stop used for narrowing or shortening the micropins were described. Dr. Walker employed the micropuncture method in twenty-four cases, and from the ocular reactions he concluded that, because of the liability of micropuncture backflow, the bacterial flora of the lacrimal sac and the conjunctiva should be studied in smear and culture; that dehydration may be detrimental; that the canthotomy, muscle and running conjunctival stitches should not be closed too tightly, and that the dressing should be gaged to give a pressure on the soft eye of not more than normal

ocular tension, to which end a light metal shield is used for transmitting all extra pressure onto the rim of the orbit and surrounding bony parts.

ABSTRACT OF DISCUSSION

DR. ARNOLD KNAPP, New York: Dr. Schoenberg, in his excellent paper, has discussed the reasons why in some cases after operation the retina becomes reattached and in others fails to do so. I can best add to the discussion of this subject by reviewing the causes of failure in my own cases. There have been forty cases. For purposes of description, these cases can be grouped under the following headings: ora serrata tears, five; holes, twenty-seven; no holes discoverable, five; aphakia, two; perforating injury, one. Of these, four showed improvement, seven no influence and twenty-nine reattachment.

In case 1 an enormous tear extended from the 1:30 to the 4:30 o'clock meridian. An attempt was made to fasten the proximal margin. Unfortunately, at the last puncture a hemorrhage occurred, which recurred after two days. When the media became clear, the retina was found to be detached and in folds. The condition was inoperable, as the size of the tear was too great to attempt shutting it off by operation.

In case 2 the sclera was so thin that it was blue. On perforation there was a large escape of fluid vitreous with collapse of the eyeball, so that a further attempt at coagulation seemed unwise. The eye recovered with unchanged vision and field, and the detachment was still present. Another attempt may be made later on, but whatever is done will have to be accomplished at the first attempt. Possibly the Gonin operation with cautery would be the best method.

In case 3 the area of the hole was shut off by coagulation. The detachment recurred, but, as no lesion could be recognized, no further operation was done on account of the patient's age (72 years).

In case 4 there was a large detachment with the hole far back. It was difficult to apply the electrodes far enough back because of a prominent orbital ridge. Partial reattachment occurred.

In cases 5 and 6 the detachment accompanied choroiditis. There were no holes or suspicious lesions discoverable in the retina. Electrocoagulation succeeded in improving the field and partly replacing the retina; vision has improved, but a shallow detachment is still present.

Case 7 was one of total detachment with a large hole in the retina very far back, which had been operated on. The attempt to close this opening did not succeed, and the detachment is unchanged.

In case 8 there was a total detachment with no visible hole. Several operations had been attempted elsewhere. A line of coagulations was made in the lower half of the eyeball without any effect in replacing the retina.

In cases 9 and 10 the patients were both aphakic. The retina hung down from above in both. There were no holes to be seen, but there was a preretinal band in one case and retinal folds in the second. Electrocoagulation was followed by adhesion of the retina above, but a month later a detachment formed below. Another coagulation below did not replace the retina. No further operation will be undertaken, as the condition is regarded as a disturbance of the vitreous.

Case 11 is interesting, as the detachment followed the successful removal of an intra-ocular foreign body by the scleral route. There were faint vitreous bands between the two wounds of the sclera, and the retina underneath this region was detached. This area was coagulated, and the retina is being held in place, though it is still partly detached.

An important point in the successful treatment of retinal detachment is the recognition of the hole or retinal lesion. Experience has shown that closure of the hole is essential to success, and a great deal of time must be given to this search. If there are opacities in the vitreous or in the lens, a very strong light will be helpful. As it is difficult to gage the position of the hole in a prominently detached retina it may sometimes be advisable to tap the detachment and then examine the patient again.

As the detachment follows the laws of gravity, the causative site may not always be found at the point of greatest detachment. It is a good working rule to concentrate on the upper quadrant, where the holes frequently develop.

It is self-evident that the more peripheric the opening, the easier the access is. Also, there is a limit to the size of the hole that can be closed by this operation.

The detached retina must be capable of unfolding, so that it can become flattened out and reattached.

The condition of the vitreous is also most important. A moderate escape of subretinal fluid at the site of the electrocoagulation is favorable, but the appearance of firm vitreous at the puncture sites is not desirable, as it indicates a new opening into the retina. If the vitreous is fluid from extreme degeneration, the eyeball collapses and further operation is difficult.

There are a number of instruments and types of apparatus in use which can all give good service. It would be an improvement if one could vary the amount of coagulating power in the current employed according to the conditions found in each case.

Ophthalmologists are learning to recognize the cases of detachment of the retina in which a cure can be expected, and the results which are being obtained in this condition with electrocoagulation are truly remarkable. It is no longer legitimate to lose time by nonoperative methods of treatment. If the case is suitable for operation, the sooner it is done, the better will be the results.

Dr. Harry S. Gradle, Chicago: The question of surgical treatment of detachment of the retina is still an open proposition. Advocates of various types of operation have published statistics of cases that number from a few to several hundred, and no two operators show any great degree of unanimity. As a result, one can merely grope in the dark and try everything, regardless of strict surgical indications. It is still impossible to offer a definite prognosis before operation, and it will probably be some time before any prognostic conclusion can be reached.

I wish to offer a few of my observations based on a limited number of cases. These cases date from the first part of 1929 to August 1933, so the shortest period of observation of any case has been in excess of ten months. I have performed fifty-eight operations on thirty-nine

patients: in twenty-seven cases, one operation; in seven cases, two operations; in three cases, three operations, and in two cases, four operations. About half of these were Weve operations, and the other half were equally divided between the Guist and the Gonin operation. In twelve patients an anatomic reattachment persisted.

Allow me to speak of the contraindications to operation: The detachments of pregnancy should never be attacked surgically. The large funnel-shaped detachments of high myopia offer a hopeless outlook. The flat detachments that have existed over a longer period of time usually are beyond hope. The detachments occurring in aphakic eyes offer a bad prognosis, although operation is not contraindicated. Detachments in association with anterior uveitis are apt to be uninfluenced by operation. Detachments in association with tuberculosis of the retina and choroid do not yield satisfactorily to operation.

Prognostically, what detachments can be considered hopeful from a surgical standpoint? First come the detachments of the lower degrees of myopia, either with or without a tear. However, these degenerate fairly rapidly, so that operation should be performed within the first three months.

Next come those that one thinks may be due to blunt trauma. Here, too, time is an element and the sooner the operation is performed, the better are the chances for reattachment. In the cases associated with exudative processes in the retina and choroid (excepting such as are tuberculous) there is a fair chance of success by operation, unless the basic lesion is located near the posterior pole of the eye. Time does not seem to play the enormous rôle here, but it does in some of the other forms. One case of this type occurred in a man 39 years of age. The detachment in the right eye was of one year's duration, and that in the left eye of three years' duration. A Weve operation was performed on the right eye, with complete anatomic reattachment and resulting vision of better than 4/10. But interestingly enough, during the patient's three weeks' rest in bed subsequent to operation, the left retina that had been detached for three years became reattached in all except one quadrant, but without useful vision. Now, I wonder whether my operation or the enforced rest in bed was the cause of the splendid result.

Regardless of these suggestions, I still believe that one should operate in every case of retinal detachment that offers any possible chance of success. To operate merely in favorable ones for the purpose of bolstering one's batting average may be a good thing for the individual patient and for the operator's record, but will not help the physician to determine the strict surgical indications for operative intervention in cases of detachment of the retina.

DR. DOHRMANN K. PISCHEL, San Francisco: Dr. Walker has given a very complete description of the various instruments he has made for performing the Šafář multiple diathermic puncture.

For those who prefer using pins held in forceps, with no thread attached, I should like to show a pin I have just had made. It is based on Dr. Walker's Ringston pin. The portion for perforating the sclera is a scant 2 mm. long, and the portion above the stop is from 1 to 6 mm. long, making a very satisfactory small pin. This pin, firmly grasped in powerful cross-action forceps, is easily pushed through the sclera.

I agree with Dr. Walker in regard to the great superiority of single pins over 3 point pins. I have found that the 3 point pin can easily be tilted in pushing it through the sclera, so that one of the points will penetrate less deeply and cause less coagulation than the others, or even no coagulation at all, a serious drawback.

I also agree that insulation is not necessary on the stops of the pins. In my last two operations I used both insulated and the new noninsulated pins, and found the grayish halo which surrounds the puncture point to be no longer with the noninsulated than with the insulated one.

However, I am not as worried about the possibility of losing a pin in Tenon's space as is Dr. Walker. I count the pins carefully as they are pulled out, and therefore do not have a thread tied to them. I find the large number of threads a handicap in moving the eyeball about, as for inspection of the fundus.

This point is an important one. Inspection of the fundus during the operation enables one to determine that proper coagulation is being obtained, and that the proper area and the holes or tears are being surrounded. If one sees that this is not being achieved, the operation can be varied to correct this.

May I emphasize what was said about careful localization of holes? The type of apparatus used is not so important as the necessity for great care and accuracy, which means spending much time on examination of the fundus.

I should like to ask Dr. Schoenberg what strength of current in milliamperes he is using and for what length of time? I believe the dosage in milliamperes as well as the time is important. Granted that one is using clean electrodes and that the field is dry, fairly uniform choroidal changes can be caused by equal dosages of current. I believe that while too strong a current may cause excessive damage, one is more prone to err on the side of using too weak a current. Therefore I usually employ a current of about 80 ma. for from four to five seconds. With this current the pin must be quickly pushed through the sclera and the current allowed to continue to flow for the required amount of time. The pin must be in contact with the sclera before the current is turned on.

Another point in Dr. Schoenberg's paper that I wish to emphasize is the distribution of the pins. In his earlier cases he kept them well away from the region of the ora serrata. In his later cases he brought each end of the line of pins, or treated points, close to the ora. This, I believe, accounts for the higher percentage of successes in his more recent cases.

This type of operation, which seeks to demarcate or wall off the affected area of the retina from the remainder of the fundus, depends for success on one important feature. As Lindner, who worked out the theoretical bases of this operation, pointed out, the operation must create a solid line of choroiditis from the ora, around the affected area and back to the ora again. Coming close to the ora may not be sufficient, as a small bridge of free retina will allow the fluid to pass under it and lift off the rest of the retina, vitiating any attempt at healing. Therefore it is necessary to put the pins in close together, evenly spaced, and up to the ora serrata.

In explaining the possible cause for some of his failures Dr. Schoenberg mentioned a vitreous adherent to the retina. This is of utmost importance. If the retina is being pulled away by a shrinking vitreous, no operation can seal or wall off the hole, as the retina will not come back to come in contact with the exudative choroiditis. Therefore I feel that a case has a bad prognosis if one sees that the detached retina does not float freely, but merely quivers when the eye is suddenly moved (for this shows the solid vitreous still holds the retina).

If at all possible, one should wait for the vitreous to liquefy, thus releasing the retina and allowing it to float back into place after an operation. During the period of waiting, if stenopeic spectacles are worn, little increase in the size of the detachment will occur, unless the vitreous still pulls on the retina. In fact, the detachment may become smaller, as an instance will illustrate. This was one of a large bullous detachment temporal and above. The patient, a 60 year old man, was suffering from a cold and cough. While waiting for these to clear up he wore stenopeic spectacles but remained ambulatory. Nevertheless the field and vision improved. Finally operation brought a successful conclusion.

Dr. Gradle has pointed out the indications for this operation. In agreeing with him, I should like to point out that in cases of detachment of the retina one is dealing with a disease that is hopeless if treated conservatively. The only practical hope lies in surgical intervention. If one does nothing, blindness results; if one operates, one may save sight.

With this feeling I have not refused to operate on any patient with a detachment who wished me to do so, no matter how gloomy the outlook. The results are most interesting. In twenty-six cases in which operation was performed in private practice and at the Stanford clinic, ten complete cures have resulted. The most interesting features are brought out by dividing the cases into those with a favorable and those with an unfavorable prognosis. There were eleven with a favorable outlook, and these can be dismissed with the statement that in seven operation resulted in cure. There were sixteen cases with an unfavorable prognosis. These included instances of detachment in eyes previously unsuccessfully operated on by another method, in aphakic eyes after discission and in eyes with old iridocyclitis, with old detachment in the fellow eye; detachment of eighteen months' or longer duration, and detachment associated with keratoconus, perforating injuries or retinitis proliferans. Yet of sixteen patients with such conditions, three were cured and one was so improved that he again saw his children, although a remnant of the detachment remained. Two of these bad conditions were in only eyes.

Therefore, I feel that one should not hesitate to try to help these patients, no matter how unfavorable the outlook.

DR. L. PETER, Philadelphia: During the last eight months I have operated in twenty-one unselected cases of retinal detachment by diathermy, using the Walker unit and needles. I failed in one instance to secure reattachment of the retina. This was due to faulty technic and probably to poor surgical judgment. In the remaining nineteen cases, reattachment was obtained, and the visual fields showed varying degrees of improvement from slight enlargement to complete restoration. In

three instances of long standing, macular vision failed to improve. In one of these cases, the tear was in the neighborhood of the macula. Most of the cases in which good central vision was obtained were of less than six weeks' duration, so that the time element is important so far as central vision is concerned. However, the location of the tear in the neighborhood of the macula or the presence of considerable edema in the macula interferes with good visual results. In my experience, reattachment can be secured in most cases, but good and useful vision is largely predicated on the duration of the detachment and on the area in which it occurs.

The etiology is a second factor of importance in securing good results. Detachments due to certain forms of vascular disease, as well as those due to a shrinking of the vitreous body onto traction bands, do not yield as readily to surgical intervention as those which arise from trauma. I am, however, in accord with the essayist in believing that in addition to the etiology and the duration of the detachment, accuracy in locating the tear, if it is demonstrable, and detail in the operative technic are most important in obtaining reattachment and good central vision in most cases which are of less than a year's duration. The more recent the detachment, the better the results are, other things being favorable.

The operation is not difficult. It is within the reach of the average operator who has sufficient material to acquire finished technic. Results will be poor if care is not exercised in accurately locating the tear when it is visible, and in the minute study of the fundus when tears are not demonstrable. Results will be equally poor if good surgical judgment and refined surgical technic are lacking.

Diathermy offers a new and unparalleled future for the cause of retinal detachment if the operation is done with precision and the case is carefully studied before the operation is undertaken.

Dr. Harvey E. Thorpe, Pittsburgh: The sine qua non of successful healing of retinal detachment is still careful localization and sealing of the retinal hole. A sketch of the fundus is invaluable. If the tear is not found, an idea about its location may be gleaned from the history of the first involved field, namely, the area which was first obscured or first showed light flashes.

Ophthalmoscopic examination with the patient in a reclining position after he has been in bed two days and even after aspiration of a minim of subretinal fluid is very helpful, as suggested by Dr. Schoenberg and Dr. Knapp. More than one hole may be present and thus be discovered. This is often responsible for recurrence of detachment.

The corneal contact glass has been helpful to me in the study of the retinal periphery, especially in aphakia. I use a 12 mm. scleral curve and 7 mm. corneal curve contact glass. In one case of aphakia with detachment and an undilatable pupil the glass was helpful in finding a peripheral tear.

For the diathermic operation, to repeat what others have stressed, a dry globe and sufficient current for penetration are essential. A wet globe and insufficient current cause tissue shrinkage and scleral shortening.

Scleral pins 1.8 mm. long are used for perforation of the sclera and choroid. I use pins 1.2 mm. long near the ora to electrocoagulate the

sclera and choroid beneath it. My pins are similar to those shown today by Dr. Pischel.

Thorough familiarity with the topographic anatomy of the eyeball is essential. After-treatment should be strict. The patient must rest in bed three or four weeks, lying on the side corresponding to the detachment. The foot of the bed is elevated if the tear is above. The head of the bed is elevated if the retinal hole is below.

Much can be added to the mental comfort of the patient by permitting the use of a small radio at the bedside. Patients are extremely grateful for this.

Lindner's "hole" spectacles are of considerable help and should be used for from five to six months after permanent removal of the bandage. After two months they are left off for two hours daily. A guide is necessary on the street during this period. A patient of mine wearing "hole" spectacles stumbled, fell and struck his head. Fortunately his retina did not redetach.

I have observed insufficiency of convergence following the use of the Lindner spectacles.

DR. OSCAR WILKINSON, Washington, D. C.: There is a valuable method of coagulation for the relief of detached retina that has not been mentioned. I agree that the use of the Walker apparatus is the best method of the type in which perforation is employed. I am in hearty accord with the use of that instrument, but the transscleral coagulation method of Larsson, I think, is particularly indicated in a certain type of case. It is, in my mind, especially indicated in that type of case in which the sclera is very thin and blue—the type of case in which Dr. Knapp reports the loss of the fluid from simple coagulation, which prevents further work on the eye. The second type of case in which it is indicated is that of flat detachment near the macular region. I believe that with proper study and careful use transscleral diathermy is a valuable aid in cases of this character.

DR. MARK J. SCHOENBERG, New York: Dr. Walker's idea as to the formation of a hole in the macular area by the use of too strong a current is very interesting. He did not mention any other changes in that region. I had three patients with active choroidal processes in the macular region which I had not discovered before the operation. I obtained a complete reattachment of the retina in these cases, but the visual result was poor. All that anybody can expect from an operation for detachment of the retina is to obtain a reattachment. As far as the central vision is concerned, that depends on how healthy the retina of the macular area is. I wonder whether Dr. Walker is really certain that the diathermic current flows toward the posterior pole of the eyeball, injuring the macular area. Perhaps more experimental work and clinical observation will furnish the necessary information.

I suppose that cures can be obtained in 95 per cent of cases only if the selection of the cases is very rigorous and if every doubtful case is rejected.

I agree with Dr. Pischel that one ought to be more merciful and operate in those cases which appear hopeless, rather than reject a case in which improvement might have been obtained.

In my series the cases were not selected. I took every case that presented itself, both because I wanted to give the patient a chance, and because I was curious to see what would happen. Dr. Pischel asks what amperage I use. A study of the literature on the subject of electrosurgery, discussions with engineers and my own experience lead me to believe that the ammeter is not a reliable guide as to the amount of current to be used at any given moment. The resistance of the tissues is not always the same; nor are two adjoining areas of the outer surface of the eyeball equally resistant to the current. One has to learn by experience and by trying out the effect of various intensities of current, by using it on the eyes of animals, liver, potatoes, etc. One has to learn the workings of the apparatus one is using. The apparatus I use (Liebel-Flarsheim) has a dial indicating the "power-control." By numerous trials it has been found that for the 1 point electrode it is necessary to set the indicator at 30; for the 2 point electrode at from 40 to 50; for the 3 point electrode at 60. It is safer to begin by using a weaker current and to increase it gradually up to the point where the electrode is driven in with ease.

As far as the type of current is concerned, I have not yet reached a definite conclusion. I am sure that it will take years before it will be known definitely which is the best type of current to use.

With all respect to Dr. Walker's machine, I do not favor it, because it is too rigid; it gives me only one type of current. I prefer a machine that can furnish a coagulating current when one wants it, a cutting current or a mixed current (coagulating and cutting) in proper proportions.

Dr. Thorpe's suggestion is extremely interesting. I think that the idea should be followed up. The use of the contact glass in order to allow one to see a portion of the fundus nearer to the ora serrata, especially in cases of aphakia, is a useful suggestion.

Dr. Wilkinson's idea is extremely interesting. I always had the idea in the back of my mind that there are cases in which the Larsson method is applicable. The only trouble with this method as originally described was that the electrode Larsson used was entirely too large, and for this reason the reactions were very extensive. If one used very small electrodes, 0.5 mm. in diameter, for example, or even 0.25 mm., properly applied and held for a sufficient length of time, one could treat lesions in the macular area and cause a minimum amount of damage.

Dr. Pischel has asked how long I keep the electrode in the eye. I just go in and out. A too prolonged application of the current coagulates the retina also, and coagulation of the retina alone is sufficient to increase the amount of detachment.

Dr. Clifford B. Walker, Los Angeles: I shall show a few more of my slides, which will help to answer certain questions.

I have used the diathermic electrodes shown here most successfully for application on the eye in cases of iritis with plastic exudate, in which there is a tendency toward a high pressure, that is to say, a glaucomatous condition, so that atropine cannot be used. The application of 300 ma. through these electrodes on the eyeball over the closed lids often gives extraordinary improvement, dilating the outlets and softening the exudate. In some cases there is a little hemorrhage in the vitreous,

which is a thing to be thought of very seriously in connection with the use of cutting currents; the hemorrhage has responded to this treatment even after three months. It raises the temperature of the eyeball about 2 degrees and increases the metabolism.

The pupil glasses, or goggles, of Lindner, if made in black, sometimes lead to discomfort for the patient; for instance, if the patient goes into a bank and the cashier warns him that there is a machine gun nest awaiting burglars and other people with black bandages on, he is inclined to take them off again; so I have used aluminum glasses. These are light and are formed to fit an ordinary frame, that is, a 50 cent frame.

I shall now present a series of fields before and after operation. It is difficult to get full quantitative fields of vision before and after operation.

The first field is that of a woman having a separated retina for two years. The field above shows the condition before operation, and that below the condition after operation; vision was 20/100 after the operation, whereas preoperatively it had been much worse than that—finger-counting eccentrically at 1 foot (33 cm.).

The second field is that of a man struck in the eye during a drunken brawl who had a large retinal tear with a visual acuity of 1/200 before the operation. After the operation, he had a visual acuity of 20/70 with a very satisfactory field, but on the nineteenth day he got up and went to the lavatory and came back with a redetachment. The eye was reoperated on, and the retina was reattached above and detached below. Thus three operations were done to get this final result.

The third field is that of an engineer who received enough injury to give him a separated retina. Before operation he had light perception only; after operation he had vision of 20/100.

The fourth field is that of a woman who had a very ordinary tear of six weeks' duration. The better type of result was obtained, the visual acuity, which was 10/200 before the operation, being 20/20— after operation.

In general, I may say that, excluding cases of aphakia and cases that were of over two years' duration, in twenty-one cases of that sort I can show seventeen instances of reattachment with fields before and after, thus reporting the type of improvement obtained, one good way of checking the results. The slides showing the fields for the rest of the series of seventeen cases will now be presented.

This is the field for the Negro in the drunken brawl. He received an injury which cut his lid so that I had to wait two weeks before doing anything. He had not only a peripheral tear, but also a macular hole, the type obtained secondarily. The macular hole I do not think is ever going to be satisfactorily treated with diathermy except by means, possibly, of a Krönlein or other operation which allows much deeper access to the eyeball. I prefer to use Lindner's undermining method, usually making a little slit in the sclera at or above the attachment of the inferior oblique muscle and undermining between the sclera and the choroid 10 to 12 mm. toward the macula, with proper check of angles; then in some cases ophthalmoscopic observation will tell when one is exactly under the choroid in the macular region, as one injects 0.02 cc.

of 4 per cent potassium hydroxide solution; a field result of the sort shown is obtainable—a visual acuity of 10/200, while before it was only light perception.

CHRONIC UVEITIS: BACTERIOLOGIC AND IMMUNOLOGIC CONSIDERATIONS. DR. ALBERT LOUIS BROWN, Cincinnati.

This paper together with the discussion was published in full in the November 1934 issue of the ARCHIVES, page 730.

OCULAR LESIONS RESULTING FROM THALLIUM ACETATE POISONING AS DETERMINED BY EXPERIMENTAL RESEARCH. DR. CHARLES M. SWAB, Omaha.

This paper together with the discussion was published in full in the October 1934 issue of the ARCHIVES, page 547.

SARCOMA OF THE UVEAL TRACT FOLLOWING TRAUMA. DR. EDWARD STIEREN, Pittsburgh.

In general surgery, it is usually accepted that injury is at times a causative factor in the development of malignant tumors, some observers holding that the frequency is as high as 50 per cent. Trauma as a factor in the causation of sarcoma of the choroid aroused only passing interest among ophthalmologists until recently. The earlier writers were indifferent to it or skeptical about it, but now the question is of importance in cases in which compensation for injury is demanded, and the medicolegal aspect cannot be ignored. The author reported a case of single local injury to the exterior of the eyeball followed by the occurrence of a melanotic sarcoma of the choroid directly beneath the site of the injury. Recently reported cases of the same nature are reviewed, and the microscopic appearance of the growth in several of these cases is commented on.

DISCUSSION

DR. LAURA A. LANE, Minneapolis: One of the most difficult questions confronting industrial commissioners and compensation boards is: What part, if any, does injury play in the development of malignant neoplasms? The number of claims for compensation on the ground that a local trauma caused the subsequent development of a tumor is rapidly increasing. Awards are also becoming more frequent.

In a search of the literature I failed to find any experimental evidence that a single trauma per se has ever caused the development of a cancer. On the other hand, there is extensive evidence from several well known investigators that severely traumatized areas have not been subsequently the sites of tumors. If trauma is a cause of sarcoma or carcinoma, the injuries sustained in the war should, by this time, have furnished proof. Evidence here is lacking.

Those who are giving the most attention to this great problem find there is a definite age for cancer. The largest number of cases fall within the age period of from 40 to 60 years. Research workers are finding and confirming more frequently than ever before definite

metabolic changes in cancerous patients, such as an increased alkalinity of the blood. Carrel and others found that cancer cells proliferate much faster in culture mediums of high degrees of alkalinity. It is now recognized that the cancer cell is a cell with little cytoplasm and a large nucleus. It is well to remember that the uveal tract often contains melanomas, in which malignant tendencies are known to develop.

In my study of 507 cases of sarcoma of the uveal tract, I found only 66 cases in which trauma was mentioned as an etiologic factor. The 507 cases may be grouped as shown in table 1.

DR. FREDERICK H. VERHOEFF, Boston: I have examined a great many sarcomatous eyes, certainly over 300, and I do not recall a single one which showed any definite evidence of a trauma. I have examined many eyes that had been severely injured, and I do not recall one in which a sarcoma developed. It seems to me to be unreasonable to assume that a sarcoma results from an injury. One cannot deny that it is possible, but the whole point is: Is it reasonable?

DR. LOUIS BOTHMAN, Chicago: Dr. Lyman Copp, of Marshfield, Wis., sent an enucleated eye from a patient, Mr. C. G., aged 28, to the laboratory with which I am associated, and gave the following history: On April 30, 1929, the patient was kicked in the face and right temple

TABLE 1.—*Grouping of 507 Cases of Sarcoma of the Uveal Tract*

	Iris	Ciliary Body	Choroid
Cases	77	54	376
Traumas	7	6	53

by a horse, and immediately lost the vision in his right eye. Because of the severe injection, the roughened corneal epithelium, the loss of the red reflex, the numerous synechiae, the intense pain, the lack of perception of light, the small flocculent exudate in the pupillary space and a tonometer reading of 45 mm., the eye was enucleated on May 8. The choroid was in situ except for a jet-black tumor-like mass, 2 by 7 mm. widening to 8 by 10 mm., on the nasal side of the optic nerve. On histologic examination, this mass proved to be a melanosarcoma of the choroid measuring 8 by 9.5 by 11 mm. It was of the mixed-cell, nodular variety. Had this eye not been enucleated until several months after the accident, one might easily have concluded that the sarcoma was the result of the trauma. The fact that it was enucleated nine days after the accident excludes all possibility of the sarcoma being a result of the trauma since it could not have developed in so short a time.

DR. ADOLPH O. PFINGST, Louisville, Ky.: The greater frequency of malignant growths in parts of the body that are most exposed to injury—for example, the female breast, the mouth and the extremities—and the greater frequency of tumor development in persons most exposed to trauma constitute further evidence of the influence of traumatism in the production of tumors. On the other hand, when one takes into consideration the relatively infrequent development of new growths as compared with the frequent subjection of the body to injury, one cannot readily subscribe to the belief that one has in trauma the sole cause of their development. The rather frequent occurrence

of malignant growths of the uveal tract of the eye, which is surely not an especially vulnerable structure, also indicates that contributory or predisposing factors must play a part in the development of neoplasms. One knows, of course, that Virchow in his original publication maintained that the trauma serves only as the exciting cause, and that a local predisposing anatomic anomaly, the result of a congenital malformation or of a constitutional influence, plays the more important part in tumor development.

DR. WILLIAM BENEDICT, Rochester, Minn.: I have gone over my statistics and have looked up that relationship as regards the various types of tumors and the claims made by the patients which were considered to be significant of injury. The incidence of injury in 1,439 cases of tumor of the eye observed at the Mayo Clinic was as shown in table 2.

TABLE 2.—*Incidence of Injury in Cases of Tumor of the Eye*

Type of Tumor			Cases	History of Injury	Percentage
Epithelioma, primary cases			510	58	11.37
Epithelioma, secondary cases			182	20	10.98
Melano-epithelioma			126	9	7.14
Intra-ocular	83	5			
Orbital	20	4			
Eyelid and caruncle	13	0			
Conjunctiva	10	0			
Sarcoma			75	13	17.33
Carcinoma			33	1	3.03
Intra-ocular	2	0			
Extra-ocular	31	1			
Glioma			55	2	3.63
Angioma			109	5	4.58
Cysts			152	1	0.65
Osteoma			22	4	18.18
Endothelioma			16	1	6.25
Fibroma and fibroneuroma			15	1	6.66
Granuloma			15	2	13.33
Tuberculoma			4	1	25.00
Papilloma			38	0	
Miscellaneous tumors			87	1	1.14
Totals			1,439	119	Av. 8.26

These statistics mean only this: The claim that an injury has caused the tumor is made in the presence of certain types of tumor more often than it is in that of others. Neuroblastomas occur in children, in whom one does not expect to find so much history of injury as in older persons, in whom melano-epitheliomas develop. The types of tumors that develop in later years run parallel with the history of injury; so, after all, the relationship may be purely incidental and have little significance so far as cause and effect are concerned.

PRACTICAL DETAILS IN THE ORTHOPTIC TREATMENT OF STRABISMUS. DR. GEORGE P. GUIBOR, Chicago.

This paper together with the discussion appears in full in this issue of the ARCHIVES, page 887.

ROUTINE EXAMINATION OF MUSCLES IN PRACTICE. DR. JAMES WATSON WHITE, New York.

The observations necessary to make a diagnosis were considered, and the various tests used to obtain them were discussed. A routine procedure was outlined for all cases, and variations from this for special cases were described. The various tests were compared as to time consumed, accuracy and adaptability to the largest percentage of cases.

DISCUSSION

DR. EDWARD C. ELLETT, Memphis, Tenn.: Dr. White's advice appeals to me forcibly when he says that the routine tests should be as simple and as few in number as is possible to give the necessary information, and that more elaborate tests should be reserved for those patients who show evidence of muscle imbalance. The objective tests are properly emphasized, but the principal objective test, the screen test, is one which I have not found very easy to utilize in the case of small errors, and especially in that of vertical errors, possibly because I do not use it enough, and possibly because I have not used it with the eyes directed in different directions, as Dr. White suggests. I have long been in the habit of making the distance test with the Steven's phorometer and not using other tests unless this indicated some error. I recently tabulated the results of the distance tests in 140 patients, as follows: orthophoria, 66; esophoria (from 1 to 3 degrees), 23; exophoria (from 1 to 3 degrees), 51. In several thousand cases reported by different observers and cited by Peter, the percentage of hyperphoria varied from 7 to 35, the hyperphoria being mostly of 1 degree or a little more. The Maddox rod is often employed, and its use has seemed to me to yield results comparable in accuracy with those of any other subjective test. While such tests are subject to criticism, it must be remembered that the question of symptom-producing muscle errors does not come up in examining young children or persons of subnormal mentality, and in examining intelligent persons the phorometer, Maddox rod and similar means of tests can be satisfactorily used.

The object of one's effort is to relieve symptoms, and in reviewing mentally a large number of patients to whom I have ministered for their relief from some form of asthenopia, an opinion expressed by Professor Fuchs has impressed me forcibly. "One does not," stated Professor Fuchs, "conclude that all the complaints which are expressed in the presence of a heterophoria are actually related to it." The object of this remark and of my quotation of it is not to deprecate the necessity of a careful study of the muscle balance and muscle function. but to put the influence of muscle errors distinctly secondary to that of errors of refraction and the proper adjustment of spectacle frames. Many patients with undoubted muscle errors, some of high degree, are not inconvenienced thereby.

In reference to the tests of muscle strength by prisms, whatever they may be called, I find myself quite in accord with the views expressed in the paper. As far as the tests for abduction or prism divergence and the vertical tests go, they seem to be constant, reliable and often valuable. The tests for prism convergence are not. The

adduction, tested in this manner, can be greatly increased in a few minutes, and the test does not seem, in most cases, to add much of value to the investigation.

Dr. M. Davidson, New York: In work on cases in which compensation is claimed, subjective tests are unsatisfactory. The cover test does not lend itself to charting and recording in demonstrations before judges. I have therefore cast about for other tests with which to supplement and check up, and I have located two tests that are to me objective performance tests. One is the Hess method of graphic registration, which is not very well known but is now described in Brown's translation of Fuchs' *"Lehrbuch der Augenheilkunde"* ("Diseases of the Eye," translated by E. V. L. Brown from the fifteenth German edition, Philadelphia, J. B. Lippincott Company, 1933). This informs one of any static deviation that may be present in a pair of eyes. It gives what I should call "the total heterotropia" in a case, the idea of which is similar to the idea one has of total hyperphoria. It includes the manifest hypertropia plus the latent hyperphoria which also exists.

The other test which I have employed regularly for many years is a multiplication of the Perlia stereoscoptometric device. It is similar to charting diplopia, except that one does not use a luminous object, but uses a spherical test object such as Dr. Berens employs for perimetry, and the patient or the claimant is given a similar test object. The examiner's test object is held about 2 inches (about 5 cm.) in front of the tangent curtain, and the patient is asked to come up and touch it vertically from some distance. If there is diplopia, the test is negative, because there is no binocular defect in the field of diplopia. This is a performance test. A contrasting color enhances the effect. It rules out any possibility of monocular accidental stereopsis. The contrasting color is held by the examiner at a point 50 cm. from the patient, and then the test is repeated at regular intervals of 5 degrees up to 30 degrees against a tangent curtain. A complete record of the field of diplopia can be had on the regular tangent curtain without asking the person whether he sees double.

Dr. James Watson White, New York: My objection to the phorometer and the Maddox rod is: They are tests which give one a chance to use fusion. They are supposed to break up fusion, but many things do not do what they are supposed to do. I examined a patient last week who had 8 degrees of exophoria by the screen test and 7 degrees of esophoria by the Maddox rod test. The same principle is carried to a further extreme by Dr. Marlow's occlusion test. There is no doubt but that Dr. Marlow will bring out latent phorias which I do not bring out with the cover test, just as I bring out deviations which are not brought out by the Maddox rod or by the phorometer.

Observations on Four Thousand Optic Foramina in Human Skulls of Known Origin. Dr. John E. L. Keyes, Youngstown, Ohio.

This paper together with the discussion will be published in full in a subsequent issue of the Archives.

HEMANGIO-ENDOTHELIOMA OF THE ORBIT: REMOVAL THROUGH TRANSCRANIAL APPROACH. DR. ALFRED W. ADSON and DR. WILLIAM I. BENEDICT, Rochester, Minn.

This paper together with the discussion was published in full in the October 1934 issue of the ARCHIVES, page 484.

UNILATERAL CENTRAL ANNULAR SCOTOMA PRODUCED BY CALLUS FROM A FRACTURE EXTENDING INTO THE OPTIC CANAL: REPORT OF TWO CASES. DR. WALTER I. LILLIE, Philadelphia, and DR. ALFRED W. ADSON, Rochester, Minn.

This paper together with the discussion was published in full in the October 1934 issue of the ARCHIVES, page 500.

ANTERIOR LENTICONUS. DR. BENJAMIN RONES, Baltimore.

The author made a careful study of this rarely encountered lesion. He reported a case and illustrated his report with pictures. An explanation of the embryology of the lesion was given.

DISCUSSION

DR. CLYDE A. CLAPP, Baltimore: The great difficulty in discussing anterior lenticonus is that few have seen the condition either clinically or embryologically. It is of interest that the first description of a case (Webster's) was from Agnew's clinic in New York, although published in German.

Many of the cases reported, as shown by Dr. Rones, occurred in young adults or middle-aged persons, and in some the condition disappeared later. It is my opinion that in these cases the condition was not lenticonus, and under more accurate study by means of the slit lamp would have been found to be the result of the presence of fluid under the capsule or possibly of a cystlike structure undergoing absorption. Certainly if the condition is analogous to posterior lenticonus, there is a structural change in the lens itself, which in my experience is always congenital.

As to the etiology, it seems that the congenital is entirely different from the acquired type. In considering the congenital variety, I could imagine that a delayed separation of the lens vesicle from the surface epiblast might cause some alteration in the shape of the lens without leaving an opacity, although this would be very unusual. The idea of von Hess and Feigenbaum that a weakening of the capsule is the cause of bulging in this sector is not borne out by the slit-lamp illustrations of either Kienecker's or Feigenbaum's cases. You will see from the lantern slides that the anterior capsule is thickened rather than thinned over the bulging lens. The theory of Collins and Mayou as expressed in their textbook (Pathology and Bacteriology of the Eye, Philadelphia, P. Blakiston's Son & Co., 1911) is not quite the same as that given by the essayist. Instead of the bulging being due to a complete absence of the zonular fibers, they state that the condition "may be attributed to the failure in development of the orbiculo-anterior-capsular fibers of the suspensory ligament, which stretch from the capsule to the hinder-

most part of the ciliary body." The lack of traction by these fibers allows the lens to bulge forward at its center. This explanation, however, seems to be highly theoretical.

The theoretical explanation from the standpoint of the embryologic studies of Seefelder and Wolfrum supplemented by those of the essayist seems to be more logical than most of those which have been advanced, and I hope some clinical cases can be studied in order to clarify the matter.

BLEPHAROCHALASIS. DR. BENNETT Y. ALVIS, St. Louis.

The speaker summarized the literature to date and included a tabulated review. He reported a case from which note was made of a new feature in the gross pathologic picture. Surgical correction had been applied in this case, and its technic was described. A histopathologic study of the specimen removed was reported.

DISCUSSION

DR. EDWARD B. HECKEL, Pittsburgh: The name "blephorochalasis" was suggested by Fuchs in 1896. Other names have been suggested, but "blepharochalasis" seems to be the most appropriate. The word itself means "lid relaxation." It is a condition of early life, as stated, and is frequently bilateral. There seems to be some relation between angioneurotic edema and the development of this condition, for it seems to begin with repeated attacks of edema of the subcutaneous connective tissues, which later result in a loss of elasticity and a consequent stretching of the skin and an atrophy of the subcutaneous tissues of the lid. Just why it involves the upper lid, no one has attempted to explain.

The treatment is surgical, and while the immediate effect may be very good, subsequently the ptosis may recur. The case which I reported in 1920 was marked by a return of the ptosis, which was then corrected by kryptok ptosis spectacles.

DR. LEO L. MAYER, Chicago: The speaker reported two cases, and called attention to the report which was made by Hollis before the Hungarian Ophthalmological Society in 1933 at the March meeting. Hollis developed the theory that not only an abnormality of the skin is present, but also a weakening of the torso-orbital fascia, with herniation of the orbital fat. He therefore recommended a microhernia operation. The skin in the pathologic area of the lid is removed entire. The fascia is freed; then eight sutures are inserted and tied over rolls of gauze to protect the edges of the skin.

DIABETIC CATARACT: INCIDENCE AND MORPHOLOGY IN ONE HUNDRED AND THREE YOUNG PERSONS WITH DIABETES. DR. C. S. O'BRIEN, Iowa City.

A biomicroscopic study was made of the lenses in 103 diabetic patients aged from 2 to 33 years, inclusive. There were 19 patients, or 18+ per cent, with acquired cataract. It is believed that this incidence is unusually high, and that a larger series would show a lower percentage with cataract. In those lenses in which cataracts developed under observation the changes were not extremely rapid; several weeks

or months were necessary for complete development. The morphology was not characteristic, but two types of cataract were most frequently seen:

1. Snowflake or snowstorm cataract: In 58 per cent of the cases the cortex of the lens showed innumerable small grayish or bluish-white flaky opacities. In a study of several hundred patients such a change has been found only once in a patient without diabetes.

2. Posterior subcapsular cataract: In 68 per cent of the cases there was a posterior subcapsular saucer-like opacity composed of confluent gray granules and often containing iridescent crystals. This type is not characteristic of diabetes; it occurs also in ocular injury or disease and occasionally in senile states.

DISCUSSION

Dr. Arnold Knapp, New York: I should like to emphasize, first, the rarity of the condition and, second, the impossibility of changing its course by treatment. I should like to ask Dr. O'Brien, in regard to the snowflake or snowstorm cataract, where the process apparently begins in the lens. Second, has he observed with the slit lamp, in any of these cases, changes in the posterior layer of the iris? Third, is it his opinion that by treatment one can retard the progress of such cataracts?

Dr. Sanford Gifford, Chicago: I have never seen this snowstorm appearance because I have seen the cataract only later, when the whole lens was opaque and one could not tell how the cataract started. I believe that the opacities develop when they are subcapsular, and that the condition stops, as in the parathyroid tetany which was observed in Goldschmidt's dogs. He would produce attacks of parathyroid tetany, and there would be a layer of opacities, and then there would be clear lens fibers laid down on top of them; then he would bring on another type of tetany and another layer of opacities would develop in this condition.

Dr. Edmond E. Blaauw, Buffalo: Those opacities in the lens have not come directly from under the capsule. The condition may be hereditary. One has to be particularly careful in making statements about lenses in cases in which the entire congenital changes are not known. In the saucer-like posterior cataracts, one should look for slits, or rather those little bubbles, and what one sees is not an exudate. The saucer-like cataract can be congenital.

Dr. C. S. O'Brien, Iowa City: Dr. Knapp asks where opacities begin. They are not subcapsular; they are not what one understands as typical subcapsular opacities; they are a little deeper in the anterior cortex, also a little farther forward than the subcapsular area in the posterior cortex. In several cases I have had the privilege of seeing the condition develop in normal lenses with nothing but a few punctate opacities, which were certainly of the congenital type. This punctate opacification goes on to complete opacification. That is to me an argument against a congenital factor, because my understanding of congenital opacities of the lens is that they do not progress except perhaps later in life, as does the coronary cataract. The opacities, then, begin in the

anterior portion of the anterior cortex and in the posterior portion of the posterior cortex, but are not subcapsular.

As regards the iris, my associates and I have looked for changes. The only change we have found that might indicate a disturbance such as one sees under the microscope was in the pigmented epithelium of the iris; the only pigmentation we could see was, in a few instances, the appearance of pigment on the posterior portion and, in some instances, fine deposits on the anterior surface of the lens, but not in all cases.

I disagree with Dr. Gifford as to these snowflake opacities appearing under the capsule in the subcapsular area and then, owing to the formation of new lens fibers, retrogressing, or progressing toward the nuclear area, because I have seen these opacities come on, not in the subcapsular area, but deeper than that, and have seen them progress over a period of weeks and in some instances over a period of months. Lens fibers cannot be laid down that fast.

As to Dr. Blaauw's feeling that perhaps these opacities are congenital, I have to say only that I have watched them develop with a rapidity that does not conform to the development of perhaps the only congenital opacity which is known to develop—the coronary cataract.

ETIOLOGIC DIAGNOSIS OF CONJUNCTIVITIS. DR. PHILLIPS THYGESON, Iowa City.

This paper together with the discussion was published in full in the November 1934 issue of the ARCHIVES, page 676.

PULSATING EXOPHTHALMOS DUE TO INTERNAL CAROTID-JUGULAR ANEURYSM: THE USE OF THORIUM DIOXIDE IN LOCALIZATION. DR. T. L. TERRY, Boston.

The author presented a case of arteriovenous aneurysm between the internal carotid artery and the jugular vein with an associated pulsating exophthalmos, and described an aid in diagnosis, namely, roentgen study with thorium dioxide. An explanation offered for the pulsating exophthalmos is that it is due to a small communication or to lack of communication between the paired venous sinuses.

DISCUSSION

DR. ADOLPH O. PFINGST, Louisville, Ky.: More than 600 cases have been reported since pulsating exophthalmos was first described by Benjamin Travers in 1809. The latest compilation made by Harcourt in 1930 includes 621 cases. Travers was of the impression that his case was one of cirsoid aneurysm of the orbit. He was the first to ligate the common carotid artery for relief from this type of aneurysm.

Not long after Travers' original publication, the fact was established by autopsy that in many of the cases pulsating exophthalmos is not of orbital but of intracranial origin and that in most of them it is brought about by arteriovenous communication. In 1907, de Schweinitz and Holloway, in their classic treatise on pulsating exophthalmos, pointed out that in the majority of cases of this kind the condition is due to communication between the internal carotid artery and the cavernous sinus. This is especially true of the traumatic cases, which comprise

about 77 per cent of all arteriovenous aneurysms. The spontaneous type of pulsating exophthalmos can be attributed to arteriovenous communication in only a little more than half the cases, the other half being about equally divided etiologically between orbital tumors and simple aneurysm of either the internal carotid or the ophthalmic artery.

Just what the mechanism of the production of arteriovenous communication is has not been satisfactorily explained. However, it is a fair assumption that a weakness of the walls of the adjoining vessels exists, which brings about the communication. Congenital arteriovenous fistulas have been found by pathologists, and it has been suggested that such fistulas may lie latent for years and lead eventually to an end-to-end anastomosis of the vessels, creating an aneurysm. However, the incidence of arteriovenous aneurysms according to age does not bear out this theory, for the average age at which the reported cases of spontaneous pulsating exophthalmos occurred was near the end of the fifth decade of life, and the condition was infrequently observed in patients less than 20 years of age. Contrary to these observations, I have just observed a case of spontaneous unilateral pulsating exophthalmos in a child 20 months old, and I found a record of one occurring in an infant of 16 months.

The diagnostic measure of injecting thorium dioxide into the vessels is new to me, and I regret my inability to enter into the discussion of this feature of the essay. However, it seems to me a rather formidable and hazardous measure on account of the danger of an accumulation of the chemical in the system.

DR. MONT R. REID, Cincinnati: In general, the problem of dealing with intracranial or merely subcranial abnormal arteriovenous communications, whether or not they are associated with pulsating exophthalmos, is complicated by the dangerous procedure of having to ligate a large artery proximal to the point or points of communication. It is well known that such a procedure is attended by much more serious complications than is the ligation of an artery for arterial aneurysm or for any other condition not due to arteriovenous communication. In the extremities such ligations have been attended by an enormously high incidence of gangrene, and in the cases of intracranial arteriovenous communications the incidence of cerebral complications is much higher.

In the case of the intracranial lesions, one is almost forced to adopt the procedure of ligating the large artery proximal to the communications, because thus far it has been technically impossible to attack the communications directly. To avoid a high incidence of cerebral complications, Matas advised use of the procedure of having the patient temporarily occlude the carotid artery until he can do it for a long period without causing cerebral symptoms. After this point is reached, the operative procedure, as fairly universally agreed, should be one in which the occlusion of the carotid artery can be removed in case cerebral complications develop. For this procedure, most operators have used aluminum bands. In addition to the use of the aluminum band, I have uniformly practiced ligation of the external carotid artery. In two or three cases I have had to remove the band because of the development of cerebral complications and have later reapplied it, with cure of the aneurysm and without cerebral complications.

As pointed out by the speaker, the ligation of a vein to prevent too rapid shunting of blood back to the heart has been advocated. Brooks has advocated opening the internal carotid artery and inserting an embolus of muscle which would go up and block the fistula. In connection with these procedures, it is well to remember that de Schweinitz and others have obtained a cure in a good many cases by ligating the large supra-orbital vein. And, as pointed out by Dr. Terry, pulsating exophthalmos may result from abnormal arteriovenous communications which are, in fact, extracranial. His case seems certainly to be of this type. It is most interesting to note that the condition in his patient apparently developed without any definite prior injury which could be established as the cause. One naturally wonders if the condition was not congenital or at least preceded by a long-standing deep angioma which, as the result of stress or strain, took on the characteristics of a cirsoid aneurysm exhibiting a thrill and a bruit. The occurrence of just one spontaneous communication between large arteries is extremely rare, except in the case of a thoracic aneurysm, which may rupture into the vena cava. If his case is on the basis of an angioma or a cirsoid aneurysm, or is congenital, the chances are that the ligation of the carotid artery will serve only to ameliorate the condition for a period of time and that the symptoms will recur.

SOME FACTORS CONCERNED IN THE CORRECTION OF APHAKIA. DR. ALFRED COWAN, Philadelphia.

This paper together with the discussion was published in full in the October 1934 issue of the ARCHIVES, page 571.

Book Reviews

Ocular Dioptrics and Lenses. By G. F. Alexander, M.B., C.M., Edin. Price, $4.75. Pp. 216, with 62 diagrams. Baltimore: William Wood & Company, 1934.

This book deals with the theory and practice of ophthalmic optics and the clinical management of errors of refraction.

Beginning with the simple laws of refraction, the reader is carried through the mathematical and graphic reasoning and solution of the formulas for a simple refracting system, the commoner forms of ophthalmic lenses; the correction of the ametropic eye and the imagery of the eye and a lens being described. There are a number of original diagrams.

Although it is not so stated, the book is meant to be more in the nature of an essay than of a textbook. For while the author goes into considerable detail to explain mathematically the basic principles and fundamentals of optics, nevertheless there is no doubt that he takes it for granted that the reader is already familiar with the subject. In the opinion of the reviewer, it seems that a work of this type is more likely to confuse than help the beginner in ophthalmology.

Chapter 11 is devoted to the author's own theory of accommodation. It is interesting. He argues that increasing convexity of the crystalline lens is brought about not solely by the relaxation of the zonule which allows the lens to assume a more spherical form by reason of the elasticity of the capsule, but is augmented by a certain pressure brought to bear around the equator of the lens through the medium of the zonule and the fluid in the canal of Petit. His argument against the observations of Hess and others concerning the sagging and tremulousness of the lens under maximum accommodation is that under a strong effort of the ciliary muscle the fluid in the canal of Petit is forced into the potential space between the lens and the hyaloid membrane at the fossa patellaris, thus allowing the lens to float, as it were, on the hyaloid membrane.

He recommends a 16 per cent solution of homatropine as a cycloplegic which acts as effectually as atropine, eventually paralyzing the ciliary muscle within thirty or forty minutes, with complete recovery within thirty-six hours, or, after the instillation of 2 per cent physostigmine (eserine), within three or four hours. He has never had a patient who complained of any symptom of toxemia other than dryness of the throat, as naturally only a minute drop is instilled into the culdesac. Before the patient leaves the consulting room 2 per cent physostigmine is freely instilled.

On the subject of the correction of hyperopia in children, he advises: "We should only penalise with glasses those whose distant vision is short of that required for education, and those who suffer from asthenopia, have manifest strabismus, or have ever been observed to squint . . . Should a post mydriatic test be not possible we should order the glasses correcting 2/3 of the total hyperopia, or in the case

of the child squinting or having been ever noticed to do so, 3/4 of the total hyperopia."

"Having proved the presence of astigmatism, it by no means follows that we should in all cases prescribe a cylinder, as unless pronounced improvement in vision is given by it, or asthenopia complained of, or is not relieved by an obviously correct sphere, we may omit it from the prescription, and in any case we should aim at keeping the cylinder as weak as possible, never increasing its strength if this fails to effect a commensurate improvement in vision."

On the whole, the book contains a great deal of useful knowledge and sound advice, and while it gives expression to numerous opinions with which many American ophthalmologists will not agree, it may be read with benefit by any one interested in ophthalmic optics and refraction.

ALFRED COWAN.

Le traitement du décollement de la rétine, par la diathermo-coagulation pyrométrique; etude expérimentale et clinique. By Dr. Léon Coppez, Brussels, in Archives Internationales de Médicine Expérimentale, volume 9, p. 102, (July) 1934.

Dr. Léon Coppez, who, with his brother, is of the third generation of the celebrated Coppez family of ophthalmologists in Brussels, has been studying the subject of electrocoagulation treatment for retinal detachment for a number of years and has published numerous articles. The results of these studies have been collected, rearranged and completed to appear in a monograph.

After an introduction giving the various methods of treating retinal detachment, the author proceeds with his main thesis, that the diathermic scar can be graded in an absolute and objective way by measuring the temperature of the coagulated tissue. This is accomplished by a pyrometric electrode which measures the temperature of the scar at the place and moment of its formation. Lesions produced with this electrode in the eyes of animals and of man are then described; they serve to replace clinical approximations with exact anatomic studies. After physical and chemical experimental studies the method was tried on patients. The results obtained during the last two years are enumerated, and the operative steps are fully described. The author criticizes the use of a diathermic electrode in the form of a needle because it produces a fulguration at its extremity, which he thinks does not result merely in coagulation; burns may result, with injury to the retina and vitreous body. All methods except his own suffer from the important defect that they lack control. The amount of effect obtained rests solely on the subjective appreciation of the surgeon, and the effect observed at the time of operation does not necessarily correspond to the reaction present after a few days. Hence Coppez thinks that diathermic methods should be employed only when a method is followed which gives absolute control and always produces the same anatomic lesions. Bordier has shown that the only way to estimate diathermic heat is to measure the elevation of temperature in a small area directly under the electrodes. This the author is able to do with his pyrometric electrode, consisting of a small disk 2.5 mm. in diameter connected with a copper wire and a constantan wire, which are in circuit with the high frequency machine,

and a galvanometer for pyrometric measurement. The application must be for twenty seconds; this is the least time, owing to the inertia of the pyrometer. The optimal temperature is 80 C., and with this temperature the coagulation obtained is always uniform, independent of other conditions.

The operative technic consists, in brief, in the application of a limiting semicircle of scleral applications of the 2.5 mm. disk for twenty seconds for each application up to a temperature of 80 C.; the area of the retinal tear is also treated with these applications. Then at one or two places a puncture is made in a coagulated area with a fine knife, like a knife needle, to allow the subrential fluid to escape.

Twenty cases are reported in detail. In twelve the condition was unfavorable; of these patients one was cured; in three the condition was improved, and in eight it was unchanged. In the eight cases in which the condition was favorable six patients were cured, and in two the condition was improved.

ARNOLD KNAPP.

Histoire abrégée des vicissitudes et succès dans le traitement du décollement de la Rétine. By Dr. Noelle Bercieux, Lausanne. Price, 4 francs. Pp. 157. Lausanne: S. A. Payot & Cie, 1933.

Dr. Bercieux, a pupil of Gonin's, has written a short history of the treatment of detachment of the retina, arranging the study into groups according to the fundamental pathologic ideas:

1. Evacuation of the subretinal fluid
2. Relief of hypotony by reducing the volume of the eyeball or by increasing the ocular tone
3. To provoke adhesive chorioretinitis
4. To prevent traction of the vitreous body on the retina
5. Treatment based on the pathologic studies of Leber, as revived by Gonin

Gonin accepts Leber's statement that spontaneous and rapid detachment depends on an early tear in the retina and is caused by traction of the vitreous. The subject was first fully treated by Gonin in his article "Detachment of the Retina" in the *Encyclopédie française d'ophthalmologie,* by Lagrange and Valude, and additional clinical studies further convinced Gonin of the importance of the retinal tear. He realized the necessity of careful examination of the extreme periphery of the eyeground and described two types of retinal perforations: (1) the valvelike perforation, when the adherent leaf of the retina is drawn into the vitreous by adhesions, and (2) the punched-out holes, with the torn leaf of the retina floating in the vitreous.

Gonin believes that a patch of choroiditis nearly always corresponds to the place of the tear, and that in recent cases the liquid in front and in back of the retina is identical.

In 1916, Gonin performed his first operation to close a tear with thermocautery puncture; this was successful. After that he published many articles reiterating the necessity of closing the retinal hole if the detachment was to be cured. Many of these articles are mentioned in this history, and the important conclusions are listed, beginning with the report on the pathogenesis and pathology of retinal detachment before the Société française d'Ophthalmologie in 1920 and coming to the present

day. The technic of Gonin and the ways in which it has been modified are then described. These modifications consist in methods for easier localization and in operative methods which are better suited for very large tears or for numerous tears in the same eye, such as the chemical cauterization of Lindner-Guist and the electrocoagulation of Weve.

Whatever changes the treatment of retinal detachment may undergo in the course of time, nothing can detract from the merit of Gonin's remarkable pioneer work.

ARNOLD KNAPP.

Manual of the Diseases of the Eye. By Charles H. May. Fourteenth edition, revised. Price, $4. Pp. 496, with 376 illustrations. Baltimore: William Wood & Company, 1934.

A complete description of this well known manual is unnecessary, as its appearance in a new edition bears ample witness to its world-wide popularity.

Its general make-up is unchanged, but a fair amount of new material has been added to various sections, so that the book as a whole gives the general practitioner and medical student an up-to-date outlook on the various subjects. At the same time, just as in the first edition, it is the commoner conditions of the eye which receive the most space, rare and uncommon conditions being dismissed with a few lines.

Dr. J. H. Dunnington assisted in the revision of the chapter "Disturbances of Motility"; Dr. I. Goldstein performed a similar service for the paragraphs on pathology, and Dr. Charles A. Perera revised the anatomic introductions to the various chapters.

Considered as a whole, the new edition maintains the same high standards established by earlier editions.

W. F. DUGGAN.

Atlas of External Diseases of the Eye. By Humphrey Neame, F.R.C.S. Price, 15 shillings. Pp. 111, with 51 colored plates. London: J. & A. Churchill, Ltd., 1934.

This volume consists of fifty-one colored plates of ocular conditions which can be diagnosed without an ophthalmoscope. Opposite each plate is a brief résumé of the symptoms, diagnosis, etiology, pathology, prognosis and treatment of the disease illustrated.

Considered as a whole, the illustrations portray the various conditions accurately. As most of the conditions pictured are relatively common, the atlas will be most useful to the medical student. It might well serve as a companion volume to Mayou's "Diseases of the Eye."

W. F. DUGGAN.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General pro tem: Dr. A. Churchill, 66 Boulevard St. Michel, Paris.

International Ophthalmologic Congress

Secretary: Dr. Francisco Poyales, Olozaga 3, Madrid.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. Frank H. Crawley, 5 Fitzwilliam Pl., Dublin.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. A. H. H. Sinclair, 6 Charlotte Square, Edinburgh.
Secretary: Mr. Humphrey Neame, 56 Portland Place, London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 4-6, 1935.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. A. C. Hudson, 50, Queen Anne St., W. 1, London.
Secretary: Dr. J. D. Magor Carbell, 27, Weymouth St., W. 1, London.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

Secretary: Prof. A. Wagenmann, Heidelberg.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. Arthur J. Bedell, 344 State St., Albany, N. Y.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Atlantic City, N. J. Time: June 10-14, 1935.

American Academy of Ophthalmology and Otolaryngology

President: Dr. J. M. Wheeler, 635 W. 165th St., New York.
President-Elect: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Cincinnati. Time: 1935.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

American Ophthalmological Society

President: Dr. Walter B. Lancaster, Boston.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.
Place: Hot Springs, Va. Time: June 5-7, 1935.

National Society for the Prevention of Blindness

President: Mr. William Fellows Morgan.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.
Place: New York. Time: Dec. 6, 1934.

SECTIONAL

New England Ophthalmological Society

President: Dr. Hugo B. C. Riemer, 128 Newbury St., Boston.
Secretary-Treasurer: Dr. Benjamin Sachs, 483 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Frank B. Kistner, Mayer Bldg., Portland, Ore.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Portland, Ore. Time: Spring, 1935.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Francis A. Brugman, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Noble Dick, 1115 Terry Ave., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. Harry Shearer, 405 E. Grand Ave., Beloit, Wis.
Secretary-Treasurer: Dr. W. S. Beyer, 1101 Talcott Bldg., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. Charles H. Baker, 805 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: First Friday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. J. J. Hompes, 1307 N St., Lincoln, Nebr.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.
Place: St. Louis. Time: November 1935.

Southwestern Michigan Triological Society

President: Dr. F. B. Fralich, 203 S. Main St., Ann Arbor, Mich.
Secretary-Treasurer: Dr. A. S. Barr, 201 S. Main St., Ann Arbor, Mich.
Time: Third Thursday of alternate months.

Western Pennsylvania Eye, Ear, Nose and Throat Society

President: Dr. Claude W. McKee, 229 S. Main St., Greensburg.
Secretary-Treasurer: Dr. C. W. Beals, 41 N. Brady St., DuBois.
Place: Indiana. Time: October 1935.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Arthur M. Yudkin, 257 Church St., New Haven.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. Herschel C. Crawford, 26 Lindon Ave., N. E., Atlanta.
Secretary-Treasurer: Dr. J. A. Smith, 700 Spring St., Macon.
Place: Atlanta. Time: May 7-10, 1935.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Fred Overman, 611 Hume-Mansure Bldg., Indianapolis.
Place: Richmond. Time: Dec. 12, 1934.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. F. W. Dean, 532, 1st Ave., Council Bluffs.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.
Place: Council Bluffs. Time: 1935.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. John W. Orr, 503 S. Saginaw St., Flint.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.
Place: Battle Creek. Time: 1934.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. James A. Reynolds, 78 S. 9th St., Minneapolis.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. Lawrence G. Dunlap, 101 Main St., Anaconda.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. James A. Fisher, 501 Grand Ave., Asbury Park.
Secretary: Dr. William K. Campbell, 96 Third Ave., Long Branch.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. Webb W. Weeks, 20 E. 53rd St., New York.
Secretary: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.
Place: Albany. Time: May 13-15, 1935.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. W. R. Winn, 702 First Ave., S., Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 516 Fourth St., Valley City.
Place: Minot. Time: June, 1935.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Walter Bristow, Medical Bldg., Columbia.
Secretary: Dr. J. W. Jervey, Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. C. D. Blassingame, 899 Madison Ave., Memphis.
Secretary-Treasurer: Dr. Ralph O. Rychener, 130 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. C. C. Cody, 1304 Walker Ave., Houston.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. F. R. Slopanskey, 9 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. T. F. Welsh, 920 Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Beverley R. Kennon, 142 W. York St., Norfolk.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. W. F. Beckner, 1050 Fifth Ave., Huntington.
Secretary: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Place: Wheeling. Time: May 1935.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Alfred Stahl, 55 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. W. L. McDougall, 50 Whitehall St., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 13 Queen's Park. Time: 8 p. m., last Thursday of each month.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Lloyd B. Whitham, Mt. Vernon Pl. and Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. H. H. Glosser, 448 Franklin St., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

Chicago Ophthalmological Society

President: Dr. E. V. L. Brown, 122 S. Michigan Ave., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. L. Stotter, 1148 Euclid Ave., Cleveland.
Secretary: Dr. James T. Collins, 1105 Medical Arts Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. P. Chamberlain, 7405 Detroit Ave., Cleveland.
Secretary: Dr. A. D. Ruedemann, Cleveland Clinic, Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. W. C. Davis, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. H. M. Sage, 9 Buttles Ave., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. W. Mood Knowles, 1719 Pacific Ave., Dallas, Texas.
Secretary: Dr. L. H. Quinn, 4015 Live Oak St., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. C. C. Walker, 410 6th Ave., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. Arthur F Holding, 142 Washington Ave, Albany.
Secretary-Treasurer: Dr. W. C. Mott, 214 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. E. L. Howard, 600 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. Carl F. Snapp, 26 Sheldon Ave., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Walter W. Oliver, 320 Medical Arts Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. E. L. Goar, 1304 Walker Ave., Houston, Texas.
Secretary: Dr. J. C. Dickson, 622 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. D. A. Bartley, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. Raymond E. Teall, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. A. W. McAlester, 2003 Bryant Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Russell T. Uhls, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Kenneth C. Brandenburg, 707 Security Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. F. H. Brandt, 1136 W. Sixth St., Los Angeles.
Secretary-Treasurer: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. Charles Dwight Townes, 332 W. Broadway, Louisville, Ky.
Secretary-Treasurer: Dr. J. S. Bumgardner, 1103 Heyburn Bldg., Louisville, Ky.
Place: French Village. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. R. S. Pendexter, 900, 17th St., N. W., Washington.
Secretary: Dr. Lyman B. Tibbets, 1801 Eye St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
President: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., fourth Tuesday of each month.

Montreal Ophthalmological Society

President: Dr. J. A. MacMillan, 1410 Stanley St., Montreal, Canada.
Secretary: Dr. A. L. Guertin, 410 Sherbrooke St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Frederick E. Hasty, 119 Seventh Ave. N., Nashville, Tenn.
Secretary-Treasurer: Dr. Kate Savage Zerfoss, 803 Medical Arts Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Secretary-Treasurer: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Webb William Weeks, 20 E. 53d St., New York.
Secretary: Dr. Guernsey Frey, 121 E. 60th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. John H. Judd, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Robert H. Rasgorshek, 425 Aquila Court, Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. F. H. Lee, 501 E. Franklin St., Richmond, Va.
Secretary: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. E. W. O'Brien, 5 N. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. W. D. Edwards, 389 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. E. C. Spitze, 234 Collinsville Ave., East St. Louis, Ill.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Robert E. Parrish, 712 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Secretary: Dr. Louis F. Morrison, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Secretary-Treasurer: Dr. Leon F. Gray, 1214 Slattery Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 8:15 p. m., fourth Tuesday of every month except June, July and December.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Marc Anthony, 422 Riverside Ave., Spokane, Wash.
Secretary: Dr. Raymond A. Lower, 1455 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. D. F. Gillette, 109 S. Warren St., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Clarence E. Hill, 160 Bloor St., West, Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

Tulsa Academy of Ophthalmology and Otolaryngology

President: Dr. Roy Dunlap, Medical Art Bldg., Tulsa, Okla.
Secretary-Treasurer: Dr. Marvin D. Henley, Medical Arts Bldg., Tulsa, Okla.
Place: Medical Arts Bldg. Time: Monthly.

Washington, D. C., Ophthalmological Society

President: Dr. William Thornwall Davis, 927 Farragut Sq., Washington, D. C.
Secretary-Treasurer: Dr. James N. Greear Jr., 1740 M St., N. W., Washington, D. C.
Place: Episcopal Eye and Ear Hospital. Time: 8 p. m., first Thursday in November, January, March and May.

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